ANOTHER PHOTOGRAPHY BOOK



Thomas Payne

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Another Photography Book (Thomas Payne)

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1: Cover Page

Another Photography Book

INCLUDING ADOBE PHOTOSHOP CAMERA RAW & LIGHTROOM CLASSIC



TABLE OF CONTENTS

1: Cover Page

1: Front Materials

Licensing

1: Preface

1: Table of Contents

0: Introduction
- 0.1: CAMERA RAW OR LIGHTROOM?

1: Taking Photographs
- 1.1: 1PH WHAT TO SHOOT?
- 1.2: 1CR ADOBE BRIDGE

2: Basic Camera
- 2.1: 2PH CAMERA AND SEEING
- 2.2: 2CR MULTIPLE EDITS

3: Lens
- 3.1: 3PH REJECTING REALITY
- 3.2: 3CR HISTOGRAM

4: Sensor
- 4.1: 4PH SOCIAL PHOTOGRAPHY
- 4.2: 4CR LOCAL ADJUSTMENT

5: Focal Length
- 5.1: 5PH COLOR
- 5.2: 5CR CURVES

6: Exposure
- 6.1: 6PH ON THE STREETS
- 6.2: 6CR MORE LOCAL ADJUSTMENTS

7: Depth of Field
- 7.1: 7PH PHOTOGRAPHS LIE
- 7.2: 7CR LENS CORRECTIONS

8: Motion

- 8.1: 8PH THE IDEA
- 8.2: 8CR TRANSFORM TOOLS

9: Exposure Controls

- 9.1: 9PH PHOTOGRAPHS AS DOCUMENTS
- 9.2: 9CR CATALOGING APPLICATIONS

10: Lighting

- 10.1: 10PH ROCKS and TREES

11: History of Photography

- 11.1: 11PH PAST PHOTOGRAPHERS

12: Color

- 12.1: 12PH THE DEATH OF PHOTOGRAPHY

Index

Glossary

Appendix

Detailed Licensing

1: Front Materials

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Licensing

*A detailed breakdown of this resource's licensing can be found in **Back Matter/Detailed Licensing**.*

1: Preface

This book is divided into three types of information. The first is in the main chapters. Here is where you learn photography with your camera nearby as you read. Terms in headers and in bold are fairly key to the learning, but the concepts covered are equally (if not more) important.

Sidebars

Whenever text appears like this in a box, you don't have to read it. It is just additional information that you might (or might not!) find interesting.

Learning photography doesn't work in a vacuum, so the second type of information consists of stories and links to other photographers' work. The stories are just to introduce a choice of photographers to investigate. The links to photographers are the important part.

You have to be doing to learn, so the third type of information steps you through the workings of Adobe Photoshop Camera Raw or Lightroom while you are using the application. There are other excellent applications out there, but these applications are the most ubiquitous.

Finally, this book strives for clarity, but different students have different ways of learning things. If you find that you need extra help with a term or concept, Google it—an often overlooked solution.

What do you need?

1. Reading Device

You could read this book on a computer, but a tablet is far better. Tablets don't have to cost a lot—a 7 inch Amazon Fire can be had for $30 on sale ($50 regular price), and even though it is largely ad space for Amazon, it will display PDFs like this book fine, although with some awkward scrolling required for each page.

Since this book had to be formatted for some device, it is formatted for an iPad (9.7 and 10.5 inch). So, this is the best choice for reading without scrolling to see a whole page. Any iPad will display the book properly, so if you are short on cash, consider getting a used one. Other brands of tablets will probably work fine, but since they come in many different formats and sizes, it is impossible to predict how they render views of the pages.

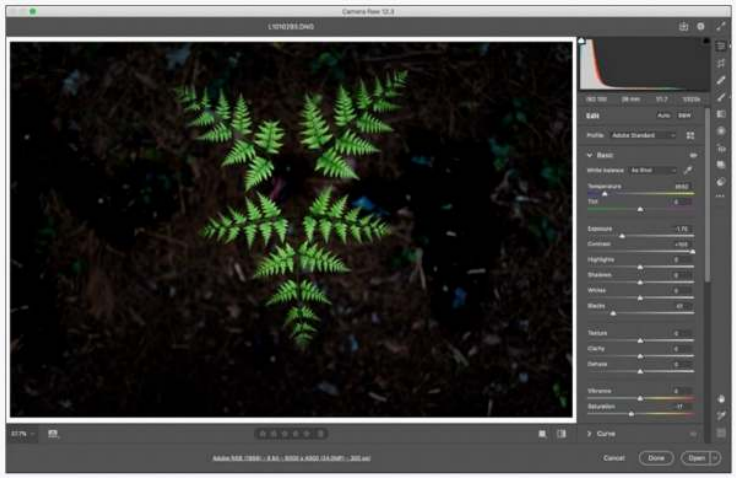
While you are at it, get a good PDF reader application. I use GoodReader and PDF Expert by Readdle, but a free alternative such as Adobe Acrobat Reader also works well. Both of these applications allow you to navigate easily, take notes on pages, and open hyperlinks in the text.

Note: This book is almost impossible to read on the small screen of a phone, although you could use it for referencing specific pages such as the application instructions.

2. Computer for Image Editing

Although this book is written for using a Macintosh computer, any other brand will work with a few changes in the keystrokes noted. Mostly you just need to know that on a Windows computer the Alt key is the same as the Option key on a Mac and the Windows key is the same as the Command key.

The Camera Raw component of Adobe Photoshop. The workspace is a little daunting at first. This book will lead you through it.



3. Photoshop Camera Raw or Lightroom

If you are reading this as part of a class, chances are you have access to Adobe Photoshop, which includes Camera Raw as a component and Lightroom Classic separately. If you are not, there are other image editing applications out there which are cheaper and might even fit your needs better. The application instruction sections (blue bars at the top of the pages) of this book are tailored to Adobe applications, however, and when they discuss a control or term, they describe how to find it in Camera Raw or Lightroom Classic. You are on your own finding it in another application.

4. Camera

A good digital camera with a memory card (32–128GB) is the most essential need here, and you won't learn much if you use a cellphone camera or even a small point and shoot camera. Image quality, flexibility, and ease of control are all much better on a good camera. So, how can you tell if it is a good camera?

It should have manual exposure controls. These cameras are identified by having Program (P) Shutter-priority (S or Tv), Aperture priority (A or Av), and Manual (M) modes. There will be a dial (usually on the top of the camera) with the selections P, AV, TV, and M (or P, S, A, and M). Make sure the camera has at least all four of these settings.

Make sure your camera has all four of these settings on the main dial.



Stick with the major brands and get one with an interchangeable lens. You don't need more lenses, but these cameras are the better ones. Cameras are not changing too much nowadays, and if you get a new one, you will have a very good camera for years. If you

can afford a better one than the cheapest line, you may or may not want to get it. These are generally just more rugged and have more fluid controls—things you may not need.

Digital SLR camera. These all have changeable lenses, although the standard lens is all you need for this book.



Manufacturer's refurbished cameras may also be a good option. These come with the standard warranty and in many ways are as good as a new camera (although they are usually slightly older models). And don't forget to ask your uncle if he has a used camera that he would consider a loan or a donation.

RECOMMENDATION 1: Digital Single Lens Reflex (DSLR) camera. These are the ones that are large because they have a moving mirror inside that directs the light to the eyepiece. Currently the cheaper Canon EOS cameras and Nikon D cameras are examples of this kind of camera. These start at around $500, but new older models are less expensive.

ALSO RECOMMENDATION 1: If you want a smaller camera with the same image quality as a DSLR, look at mirrorless cameras. These are also more stylish nowadays and have some advantages such as being quieter. Any of these that have changeable lenses

will work great. Canon, Panasonic, Sony, and Olympus are reliable brands. Again, make sure you get one with an interchangeable lens. These start around $600, but like the DSLRs, new older models are less expensive.

Relative size difference of a DSLR (on left) and mirrorless camera. These two cameras have similar capabilities and are from the same manufacturer.



DSLR or Mirrorless?

Both types of cameras take the same quality of photograph, so neither are better. But they are different. If you have a hard time deciding, maybe borrow one of each and try them out. You can at least hold them in your hand at a local store.

Camera Quality

You might notice that cameras come with widely different price tags. But even the cheapest new DSLR or mirrorless camera with the standard lens will take just as good a photograph as the most expensive—at least most of the time. So, why are some cameras more expensive?

Build quality: More expensive cameras generally are made with more metal than plastic, which gives them more resistance to abuse. Of course, it also makes them heavier.

Water resistance: More expensive cameras have seals that protect them from incidental moisture. Rain, exploding bananas, and such.

Easy controls: Generally, the more you spend on a camera, the easier it is to control the parameters of how a photograph is exposed. So, instead of controlling the shutter speed and aperture with one dial and a button, there will be two dials.

Bigger sensor: As discussed elsewhere, a bigger sensor gives better quality. But for most of the photographs anyone takes, the smaller sensor of popular DSLRs and mirrorless cameras will produce indistinguishable results.

Better photographs: Okay, it was stated that cheaper cameras and lenses take just as good photographs as expensive ones. This was qualified with most of the time. If you are taking photographs of architecture, landscapes, or anything else where sharpness across the entire picture is crucial and big prints will be made, more money spent can lead to better photographs. This also holds true with many other special uses and with lenses. For example, I doubt that you can get an extreme telephoto lens that has good optics and doesn't cost a lot. Even more so with a telephoto that allows for low-light shooting.

RECOMMENDATION 2: You can also spend much less on a camera by buying it used, but beware. I have had students who have been shortchanged on eBay with malfunctioning cameras. A ten-year old Canon or Nikon DSLR can still be a great camera (although it might not have a movie function) and it can easily cost less than a hundred dollars. Make sure it comes with a battery (which may need replacing) and a battery charger.

RECOMMENDATION 3: If you need a cheaper new camera, and are willing to sacrifice image quality, a smaller camera with a fixed (non-interchangeable) lens is an option. Make sure it has the mode controls mentioned before—look for a dial that has the letters P, A (or Av), S (or Tv), and M. Make sure it has ALL of these settings.

This last one isn't a recommendation as much as it is a resignation. I have taught digital photography to hundreds of students, and all of the serious students with these cameras have wished they had a better camera by mid-semester.

A good web site for reviews of digital cameras is Digital Photography Review—there is certainly more information than you would want, but you can just read the summaries to know more about a camera.

Stay away from off-brand cameras, and turn down your grandpa’s offer to loan you his prized Kodak camera. Unless it is a DSLR, gently tell him that the thing is probably a piece of junk in today's world and you really need a newer and better camera.

1: Table of Contents

Photography

STORIES & PHOTOGRAPHERS ADOBE PHOTOSHOP CAMERA RAW

Preface

Introduction

CAMERA RAW OR LIGHTROOM?

1 Taking Photographs

1PH WHAT TO SHOOT?

1CR ADOBE BRIDGE

1CR ADOBE CAMERA RAW

2 Basic Camera

2PH CAMERA AND SEEING

2CR MULTIPLE EDITS

2CR UNDOS & PRINTING

3 Lens

3PH REJECTING REALITY

3CR HISTOGRAM

3CR TONAL ADJUSTMENTS

4 Sensor

4PH SOCIAL PHOTOGRAPHY

4CR LOCAL ADJUSTMENTS

4CR MASKS

5 Focal Length

5PH COLOR

5CR CURVES

5CR COLORS

6 Exposure

6PH ON THE STREETS

6CR MORE LOCAL ADJUSTMENTS

6CR RANGE MASKS

7 Depth of Field

7PH PHOTOGRAPHS LIE

7CR LENS CORRECTIONS

8 Motion

8PH THE IDEA

8CR TRANSFORM TOOLS

8CR THE REST

9 Exposure Controls

9PH PHOTOGRAPHS AS DOCUMENTS

9CR CATALOGING APPLICATIONS

9CR EDITING APPLICATIONS

10 Lighting

10PH ROCKS & TREES

11 History of Photography

11PH PAST PHOTOGRAPHERS

12 Color

12PH THE DEATH OF PHOTOGRAPHY

Appendix

0: Introduction

Why do you need this book?

Let’s make this simple. If you just want to take photographs, follow these steps:

1. Open the camera on your phone.
2. *Wipe the front of the lens with your shirt.
3. Aim in the general direction of what you want to photograph.
4. Take the photograph.
5. Post the photograph somewhere.

That is it. That is all. No more to it. Skip to the end of this book —you are done.

Well, actually (you guessed it) we are not done, because I am assuming you are using this book because you want better photographs than this technique will give you, either out of interest or if you want to pass a photography class.

Cellphone cameras

There is nothing wrong with cellphone cameras. The evolution of them has been amazing, and at this point, under the certain conditions and for certain uses, they can take just as good a photograph as any camera can. And they can do things dedicated cameras cannot, such as produce instant GIFs and slow motion movies.

*I just taught you make your cellphone photographs better.

Why and How

Some excellent students I have worked with are much better at memorizing things than understanding how they work.
If you are like these students, my apologies. This book is about the why of things. Photography is not a pursuit that is learned by memorization.

However, a cellphone camera doesn’t have the control that a dedicated camera has, and control is what you should be after in using this book. In other words, with a cellphone camera you cannot pick focus and non-focus areas, adjust the amount of motion blur, adjust angle of view without losing quality, control perspective, shoot into the sun or use other difficult lighting effectively, use external flash, adjust the sensitivity of the sensor... the list goes on.

Also, the images that result from cellphone cameras are not able to be edited effectively, as they have weak tonality and color fidelity. You have very little control over how parts of the image are interpreted. Nor are they able to be cropped into a detail or enlarged successfully. Basically, you have very little control in either the shooting or the processing of the image.

This could change, and engineers are working hard at overcoming these limitations. But their objective is not giving more control, but instead producing a more pleasing image. The objective of this book is not more pleasing images, but instead more control. If cellphone cameras do allow more control in the future, the contents of this book will not be outdated, but instead they will also be relevant to cellphone cameras as well as other cameras.

So, you use a cellphone camera and I use a cellphone camera. There is even an appendix dedicated to them in this book. So why do we need the control a dedicated camera can give?

Cellphone camera image. For this one-liner an older cellphone did the job of getting the point across.



Analogy: Drawing

I am assuming you know how to draw a face. A somewhat round shape containing two marks for eyes and a curve for the mouth. There is nothing wrong with drawing a face like this. As a matter of fact, it is amazing how fully packed with information it can be. You can probably think of at least a dozen ways of controlling the face's qualities, even just by changing the mouth line to show emotions.

Now watch someone who has learned how to control the process of drawing. A line here, a line there, and before you know it a wonderfully nuanced life-like face appears like magic. It is a different level of control.

That is what this book is after. Not how to draw faces (of course), but to control the photographic process in much the same way. Although there is some control you can have with a cellphone camera (and hopefully your cellphone photographs will be better after this book), a dedicated camera allows you much more control. Like drawing, photography is communication. Communicate beautifully.

Analogy: Writing

Here are two ways of saying the same thing:

"I was the shadow of the waxwing slain by the false azure of the window pane"

“I was a bird that flew into a window”

Face drawings by the author (left) and Leonardo (right). Both show many aspects to a face and both are useful for some things. But they are different.





...both communicate the same thing, but Vladimir Nabokov says it differently in the first quote—in a way that burned into my brain cells for years to come. He can really control his words.

You have your own quotes that burn themselves into your brain cells. Perhaps a verse in a song that is just soooo good, so precise, so right. My sincere hope is that his book will help you make photographs like that.

Control of words is a reason people take writing classes. You have known how to write from an early age—you don’t need a writing class for that. But like the drawing analogy: if you want to write well, you need to learn how to control your words.

Think of it this way: If you can write a text message to someone, why might you need to take a writing class? Hopefully the answer is obvious to you.

This is not to say that the language used for text messages is somehow bad—but it is a language that has developed for a very narrow use. Just like the language of cellphone photographs where you just point and shoot.

The End of Photographers

After Macintosh computers were introduced, it was widely predicted that the job of graphic design would cease to exist. Everyone could have designers' tools—layout applications professional enough to do any job and hundreds of fonts

This text message is not one for the ages, but it functioned just fine to let me know whose seat this was.



But these predictions were wrong. The job of design is even more important now than it was back then. Effective design needs both the controls and the talent to use the controls.

A few years ago, when the image quality of cellphone camera images started to resemble those from bigger cameras, it was predicted that the job of photography would cease to exist. With the image quality of cellphone cameras, who would need a photographer any more? Some news outlets even experimented with having reporters submit their cellphone photographs for publication.

As it turns out, photographers are still needed, and those experiments doing away with them didn't work out so well. Look at media outlets, and identify the number of images you find that have been taken by non-photographers (you can tell). Unless it was one taken by a Kardashian, you won't find any at all, even with the most local newspaper.

The reason photographers are still needed is that they have the talent to make engaging images—and the controls necessary to utilize that talent. In most situations those controls rely on dedicated cameras.

As a writing class won't turn you into a writer, this book won't turn you into a photographer. But it will give you insight into how photography and photographers work. And give you more control over the process.

Watchman Island off the coast of Labrador. The cellphone camera did a fine job of taking this photograph through the airliner window and the image holds up well at this size on the screen. In other words, I didn't need the control and quality of a DSLR for this particular image.
Actually, I do wish I could clean up the color and tonality in the sky portion, something that would have been possible from a dedicated camera.
And, now that I think of it, the blue over the entire image is lacking in variation and fidelity. There are a lot of blues out there (in hue and saturation), but the cellphone camera is producing only a few.



How long do you look?

I haven't timed myself looking at photographs, but by looking at other people scooting a thumb up and down on their phones, I can guess that most photographs get less than a half-second of our attention.

The aim in this book is to make this attention last longer by learning how to control the camera and therefore the resulting photographs. To get that thumb to waver over the screen then slowly swivel off to the side. Perhaps even to elicit an emotion. A phone turn. Maybe a pass to someone else.

There are two ways to get this to happen. Either take a picture of something incredible or take an incredible picture. Or both.

Incredible can mean many things in this context. For the subject to be incredible it could be anything from a very cute kitten to something blowing up real good.

For the picture to be incredible it could be anything from enveloping light bathing a scene to a heartfelt rendering of an fleeting emotion. Or much more. I have been looking at photographs for a long time, but I never cease to be amazed at the amazing new images I see. Every term that I teach an introductory photography class I see students coming up with incredible things that I could never do. Sometimes it is brash and loud. Other times it sneaks up on you. Sometimes it is funny, and sometimes full of pathos.

The Act of Pointing

Photography is communication. It is communication firmly tied to the visual world in which we live. In its most basic form, it is the act of pointing. Hey, look—this is what I like, this is what I feel, this is what I find interesting.

I tie my photographic anchor to writing. Many people tie photographs to music, and there are certainly many parallels (think tones). You could just as easily tie photography to any other creative endeavor—dance, theater, humor, sculpting. People use all of these media for really one thing, which is communicating to fellow people.

Photography is a cool medium. I envy painters, who touch and smell when they work, who can get into their creation and even get it all over them. Photography is not like that. The camera is a separator, the visual world is a limited pallet.

But like a haiku or a limerick, those limitations can make things more interesting. When photography is done well, it can be as incredible as any other medium.

Technique

This book is mostly technical. You have to learn scales before you can compose a meaningful song. You have to learn timing before you can be a good actor. This book covers the tools used to make incredible photographs.

Literally pointing (I didn't have a telephoto lens with me for this grizzly bear in Waterton Park)



Lauren Kahler, painting clothes



Hopefully you will be making prints from some of your photographs as you work through the book. There are several reasons for this. In a purely practical sense, prints show defects in an image much more readily than the screen does. For example, if your image is too dark on the screen, the brightness range of the screen will mask that defect. The limited brightness range on a print will not.

Despite what you might think you know, printed material demands more attention than the rather ethereal material on a computer screen. I often see this demonstrated with students (oh, I didn't notice that on the screen). Studies done bare this out. People pay more attention when things exists in the physical world. They are perceived as more permanent and less fleeting. Because they are.

Some things are better in a fleeting medium like the screen. Facebook comes to mind, and do you want Twitter or even the news in a permanent printed form? Even this book?

Every day we are taught by example that screen material is to be consumed quickly and then we should move along. That thumb moving up and down over the phone is learned behavior. Do not engage (I really didn't want to know what they had for dinner), just move on. Thumb up. Thumb up.

How meaningful is it when someone sends you a birthday greeting or love letter as an email or a text? Wouldn't you rather have it as physical object? Something another human actually touched? Photographic prints can be like that actual card.

The final reason you should print is that photography is a social medium (like any other). An important way to learn the aesthetics of photography is by communicating with others. What do you like? What works? What doesn't? How could the image been done differently? These conversations work much better with prints than with screen images.

Printing a selection of your photographs has other advantages in learning how to choose and edit photographs. It will make you a better photographer, even if you never print a photograph after you get through with this book.





One of the photographs above was taken in the middle of the night. The other was taken in the middle of the day. Can you tell which is which?
Photography is not reality as we perceive it, but a perception of reality we create.

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0.1: CAMERA RAW OR LIGHTROOM?

This is a not a book to just sit down and read. You have to be doing things while reading it. One of those things is taking photographs and making them better. If you have access to Adobe Creative Cloud applications, you have two choices for cataloging, processing, and adjusting your images.

ADOBE CAMERA RAW



Camera RAW is a component of Adobe Photoshop that handles files a bit differently than the main part of Photoshop. With it you can adjust all the parameters of an image, such as exposure and contrast, but manipulations of an image are limited. When you are done with an image, the changes are not saved to the image itself, but to a separate file or a part of the image file reserved for instructions.

Camera RAW is not a catalogue program, so it does not do anything related to keeping images organized. In this book, we use Adobe Bridge for that task.

Nor is Camera RAW able to send images to a printer, so this book uses Photoshop (the main part of the application) for that task.

CAMERA RAW ADVANTAGE

The primary advantage to using Camera RAW (along with Bridge and Photoshop) is that it is flexible. You just have to keep track of where your images are. Bridge acts as a viewer for those images, and Photoshop acts as a port to print from.

CAMERA RAW NEEDS

About all you need if you are using Camera RAW is the SD card that fits in your camera and a place to store those images after you put them on the computer. This could be a separate hard drive, a local shared drive, a flash drive, or even a cloud drive.

An alternative to this is to only use the SD card (at least 32G) and navigate Bridge to the images on the card. This is not recommended for a number of reasons, but it works.

ADOBE LIGHTROOM



Lightroom Classic has exactly the same image adjusting capabilities as Camera RAW. But it is also a cataloging application in which you can keep track of hundreds or thousands of images.

You can apply keywords to help you find certain images, and you can search for images using different criteria.

Lightroom also enables you to keep your images in different sets and keeps all of the organizing of your images visual and easy. So while not as flexible as using Adobe Bridge for these tasks, it is much more powerful.

Printing can be done right out of Lightroom, so all you need is one application.

LIGHTROOM ADVANTAGE

The primary advantage of using Lightroom Classic instead of Camera RAW is that you are building a catalogue that you can take with you. If you plan on taking a lot more photographs, or just want to use one application for everything, Lightroom is what you should be using,

LIGHTROOM NEEDS

Since you are using Lightroom to start your collection, you really need a hard drive other than your SD card. This could be a 32G or larger flash drive, but if you use a flash drive, make sure that it is USB 3 drive (not just USB 3 compatible) and it is formatted for the type of computer you are using (Mac or Windows). Otherwise, Lightroom will slow waaay down.

The instructions for Camera Raw are at the end of most chapters. The instructions for Lightroom are in the appendix, but there is also a link to the instructions at the bottom right of each page of Camera Raw instructions. Adobe keeps all adjustments in Camera Raw synchronized with Lightroom, but they are implemented differently.

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1: Taking Photographs

You don’t need much instruction to start taking photographs. Chances are really really high (okay, certain) that you have already taken some. You probably even have some good images. What this text is about is giving you the tools to make you more flexible at taking photographs so that you can take better images in a variety of situations.

This chapter guides you through getting the camera settings right in preparation to take better photographs.

Camera Instructions

If you haven’t looked at your camera’s instructions yet, this is a good time to do so. If you don’t have them, it is easy to find a camera’s manual of instructions with a web search.

There is simply no way a book like this can cover all the specifics of every model of the hundreds of cameras available. But don’t worry—you will be using the camera instructions as reference, not as bed-time reading. Make sure you know where the index is.

Camera Menus

A quick menu



The controls that you need to access on a continual basis are put onto buttons, switches, wheels, and dials on your camera. Another place for these controls is a special menu that is dedicated to the most-used items. This might be called something like a quick

menu or function menu, and it may display on your rear viewing screen. These are things you need to access quickly, like changing the bright-ness (exposure) of an image.

Buttons, Switches, Wheels, and Dials

The most used buttons while shooting are the easiest for your fingers to find. Some buttons, like the +/- buttons (red arrows) have to be held down while you turn a main wheel or press another button.

All cameras have a menu button that brings up a series of menus for less commonly used settings.

Use the camera's instructions to familiarize yourself with the buttons, but don't worry about figuring out how to use them all. This book will get your there soon enough.





Controls are also found in the general menu. Among the myriad of things here are settings to customize your camera to the way you want it, such as setting the camera to beep or not beep when it finds something to focus on. This menu is sub-divided into sets for different general options like shooting and playback.



General menus are broken into sets, which are represented in this menu by the icons at the top.

Set the Camera on P

There is a big dial on your camera with different shooting modes on it. Most of these modes are not necessary if you know how the camera works, but some are crucial to learning and taking good photographs. The Auto setting is for giving the camera to someone to just point and shoot. You should go one step further and set the camera on Program (P) Mode. This setting allows more adjustments and control than the automatic mode.



The PASM dial. Some cameras will label the A as Av and S as Tv (on the right).

Viewfinder Adjustment

If your camera has a viewfinder that you put up to your eye, it also has a diopter adjustment to adjust that viewfinder to your eyesight. With your camera on, look into the viewfinder and press the shutter button lightly. You should see some things on the screen, such as focus spots or camera information at the bottom of the screen. Find the small wheel or slider near to where your eye is and adjust it so that this camera information is sharp.



Viewfinder diopter adjustment

RAW Format

You might have to go digging around in your camera instructions to find how to set your camera to save images in RAW format, but do it. RAW format will be discussed in detail later, but for now just know that it gives you the possibility for vastly better photographs.

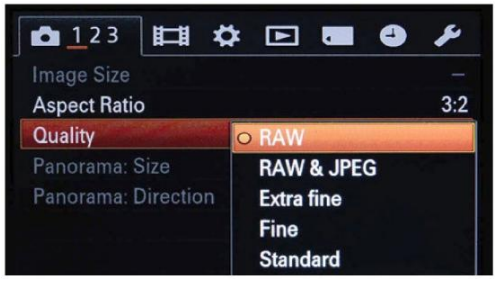


Image format setting

There are a couple of downsides to RAW format, however. First, your camera might not have it (that is a downside!). Second, your computer might not be able to display a RAW file. If either of these is the case, use the highest quality JPEG setting.

You also might see a RAW+... setting. This will save two photographs in different formats for each photograph you take. You don't need this now.

Set the ISO to 400

Again, you may need to consult the camera's instructions for how to set the ISO to 400. ISO governs the sensitivity of the camera to light. Cameras often default to an Automatic ISO, which would be great, except they normally don't do a very good job figuring out the right one. ISO 400 is a good all-around setting that gives reasonable sensitivity to light, but still retains a good bit of quality on most cameras.

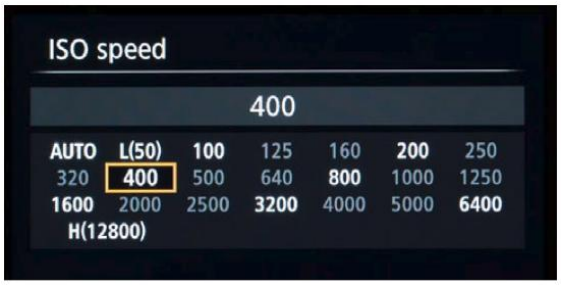
Another reason to set the ISO to 400 is that ISO is a control that is best to address separate from the other camera controls at first. For now you could increase the ISO number (perhaps to ISO 1600) if you are in low light situations in which your photographs are blurry from movement. More information on ISO is in the Sensor chapter.

Why ISO 400?

If you are familiar with ISO then you may be wondering why I am directing you to use 400. You and I both know that you will probably get less blurry pictures with the ISO at Auto.

This book isn't about getting the best photographs right away, but about controlling the process so that you can get far better photographs later. Getting those blurry photographs will teach you to pay attention to the light and how you hold the camera.

And besides, we get to the details of ISO very soon. Until then, get some blurry photographs. They will teach you some things.



Menu for ISO

More RAW

The RAW format is often not only a different format for each camera brand, but also for each camera model. Which means a couple of things.

If your camera model is newer than the software on your computer, your images might not display. Both the computer software and Adobe applications are continuously updated to recognize new cameras, so if you don't update your computer and you have a newer model camera, you will have problems. Of course the solution is to update both your computer and the Adobe software.

The other ramification is that a RAW format image is not recognized by most applications, like Word or Illustrator. This is not a problem for most uses, since you can easily generate a JPEG from your RAW image, but it is something you should be aware of.

RAW files can be identified by their unfamiliar name extensions like .CR2, .AWR, .NEF, or .DNG.

Format Memory Card

Find the menu that allows you to format the memory card on your camera. This will erase all of the images on the card (!) and prepare the card to be used with your camera.

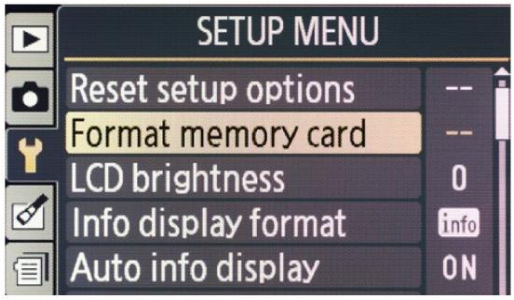
If you don’t have a memory card (usually an SD card) you will need to get one to store your images. A 32 gigabyte card has a large enough capacity to store many images. These cards are reusable, but a larger capacity card will allow you to take more photographs before downloading them to the computer or allow you to keep images on the card as back-up.

Un-Deletes

If you mistakenly delete images from your memory card, there are applications that can retrieve the erased images.
The reason this works is that when an image (like any computer file) is deleted, it is not really gone, but instead marked with a note that it can be written over. So, if you haven’t taken any more pictures, your images are still there, and an application made for the task (these are easy to find) can restore them.
If you have taken photographs after deleting your images, the old ones may or may not be retrievable.

C-RAW

For images with smaller file sizes, the newer C-RAW format compresses image files by throwing out information you probably won’t ever see.



Menu for formatting (sometimes called initializing)



Menu for date and time

Set the Date and Time

As you collect more photographs, having the correct time information becomes more important. Image files can be organized according to this date and time information. This makes it much easier to find specific images later.

Zoom

One of the first things you will notice as you play around with your camera is that by turning a ring on the lens (sometimes this is a rocker switch on the body of the camera) you can make your subject larger or smaller in the frame.

This is called the zoom. It can be used for much more than saving you a bit of walking to get closer to your subject, but for now just know a couple of things about it: The zoom position which shows the widest view is called wide angle, and the opposite setting, where things appear to be bigger, is called telephoto. Try different zoom positions with the same scene.



Typical zoom ring

Don’t Take that Lens Off!

One last thing. The sensor (which constructs the image in the camera) is very sensitive to dust. Even with newer cameras that vibrate the sensor to clean it, some dust remains and will make black spots of varying fuzziness on every photograph you take. The main way dust gets into your camera is by having the lens off. If you have different lenses, refrain from removing them for very long and always be conscious of the amount of dust in the environment when changing them.

SD Cards

Even though the different kinds of standard SD (Secure Digital) cards all look pretty much the same, the format has gone through an evolution which may make them unusable in your camera.

The order of this evolution is SD to SDHC to SDXC, with each generation enabling faster write speeds and more memory. Some cameras, especially older ones, are not compatible with some of the newer generations.

There is an alphabet soup of other numerals, letters, and symbols that go along with the card. Some of these are marketing, some are functional. Your camera instructions list the types of cards that are compatible with your camera.

If you need to know more about all the different specifications of SD cards, Wikipedia has a good page that explains what everything means.

And don’t try to clean your sensor even if you know how to get to it. Sensors are very expensive and the coatings on them are very fragile. After years of experience cleaning sensors I ruined one myself.

Now Go Shoot

When you take photographs, try to look all around your viewfinder.



Dust on the sensor. Depending on your camera settings, the dust can also show up as larger indistinct shapes. Often details hide sensor dust, but large areas without detail (like sky) will easily show it.
If there is a small amount of dust it can be eliminated (hidden) in an image editing application.

You might be taking a picture of one thing, but your camera (and the resulting image) communicates everything in the frame. Compose and crop your photographs when you take them instead of later in the computer. This will make your image-making more purposeful and preserve quality in the images.

Find a way of holding the camera steady that is not tiring and allows you to really inspect the image before you shoot it. Take your time and by all means experiment! Don't just take multiple images—instead try different ways of framing. Move up, down, try getting closer or further away from your main subject. Experimenting like this doesn't cost any money, nor does it take much time to delete the images you don't like.
Above all, look at the light. When you are taking photographs, you are not recording the things in the world, but the light reflected off of those things. The kind of light available and how you interpret it is the most important control you have.

And by the way, if you are photographing on a sunny day, a sun that is lower in the sky will present more lighting options than a midday sun.



Jenna Sarantakos. This image tells a story using the frame (composition) and light. Timing is everything in an situation such as this. Notice how a half-second difference in shooting time would make big differences.

Taking Photographs Questions

On most digital cameras which shooting mode gives more control?

The viewfinder's diopter adjustment adjusts what?

What file format gives you the possibility of getting better photographs?

What ISO setting is a good all-around setting?

What does formatting the memory card do?

What determines if the lens is wide-angle or telephoto?

Why should you be careful about taking the lens off your camera?



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1.1: 1PH WHAT TO SHOOT?

If you are hunting with a gun, figuring out what to shoot is an easy question, with the general answer being mammals that taste good when cooked.

Hunting with a camera is different. Perhaps the best short answer is hunting for things that interest you. These could be external, like a funny sign or a good friend, or it could be more internal... and perhaps abstract.

Photographs are not reality, but fairly dim reflections of it. Think of the most beautiful sunset you have ever seen compared to the most beautiful photograph of a sunset you have ever seen. The photograph probably doesn't hold a candle (punishness intended) to the real thing.

The real sunset has colors and depths that cannot be shown in the photograph. It has no frame, but gradually fades out of view until you move your eyes across both the details and the scape as a whole.



This is not a photograph of the sunset, but an aspect of it. The real sunset was beautiful (I remember it), but what interested me was a photograph of small people doing what they do, which in this case is not much.

And it goes beyond the visual. That real sunset is often accompanied by a cool breeze. Perhaps it breaks you out of the routine and stresses of the day, giving over your attention to the joys of just being alive. It may give you insights into time, as you can almost see that orb move as it dips below the horizon. It is a temporal experience—you will never experience any second of that sunset ever again.

You could be with someone else, and sharing that experience can add intangible dimensions into your knowledge of that person. I could go on, of course, and probably so could you.

The point is that photographs are not reality, nor can they compete with it in this way.

But back to what you take photographs of. You might take a photograph of that sunset to remind you of that feeling you had or perhaps to capture another experience—a part of that sunset that does translate into a photograph. That would be an external approach.

Or, you could take a photograph of colors that are pleasing together, like an abstract painting that has little or nothing to do with the actual sunset. This would be more of an internal approach—the world as raw material for something you are making.

While you are at working through this book, look at other photographers' work. Yes, I know you see photographs every day, but looking at curated (filtered) images that are recognized to be great helps to keep you from the circle of GIGO (Garbage In, Garbage Out). Learn from the best—you can get back to Facebook, Instagram, Twitter, and Pinterest later.

Following are some links to get you started looking at good photographs. If the link looks interesting, go to it. If it doesn't, then don't. Hopefully you are reading this in an tablet application that brings you back to the text after looking at the web. If not, consider reviewing the recommendations on the first page of the preface.

One good general site is **Wiki Art**, which is incomplete, but easy to scan. Just spend a bit of time looking at thumbnails and when you see something you like, remember the photographer's name to pursue it more, perhaps by doing a Google Image Search. The

Museum of Modern Art also has a good search function, and the **San Francisco Museum of Modern Art** has easy to navigate thumbnails to choose photographers. The **Fotografiska Museum** is really not a museum but a photography gallery with excellent exhibits.

Other good sites include the **Center for Creative Photography** if you like classic landscapes, the **International Center of Photography** if you like photojournalism, **American Suburb X** for more a mix of contemporary and classic photographers, **American Photography** for a more commercial approach with a good newsletter.

There are a few magazines that also have good images online. **Lightwork** and **Aperture** are two that often show contemporary photographers. **The British Journal of Photography** is a stalwart among publications, and they continually remind you they have been around since 1852. For a magazine dealing with a variety of contemporary media with roots in photography, try **AfterImage**.

Galleries' web sites show the work of photographers they represent. The **Catherine Edelman Gallery** and the **Edwynn Houk Gallery** are two worth checking out, and there are more that have links later in this text in connection with individual photographers.

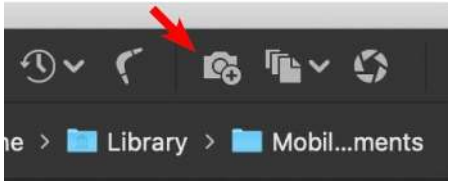
There are also resources that have interesting writing about photography. **The Image, Deconstructed** has interviews with photographers, **Burn Magazine** features essays about photography, and **Autograph** is tuned to diversity in photography. **American Photo Magazine** covers both commercial and fine art with an eye towards current trends. For technical things, **The Art of Photography** has videos (which are not always accurate, but may be interesting), **PetaPixel** is kind of like the People Magazine for photography, and the already mentioned **Digital Photography Review** can keep you up with new ways to spend money.

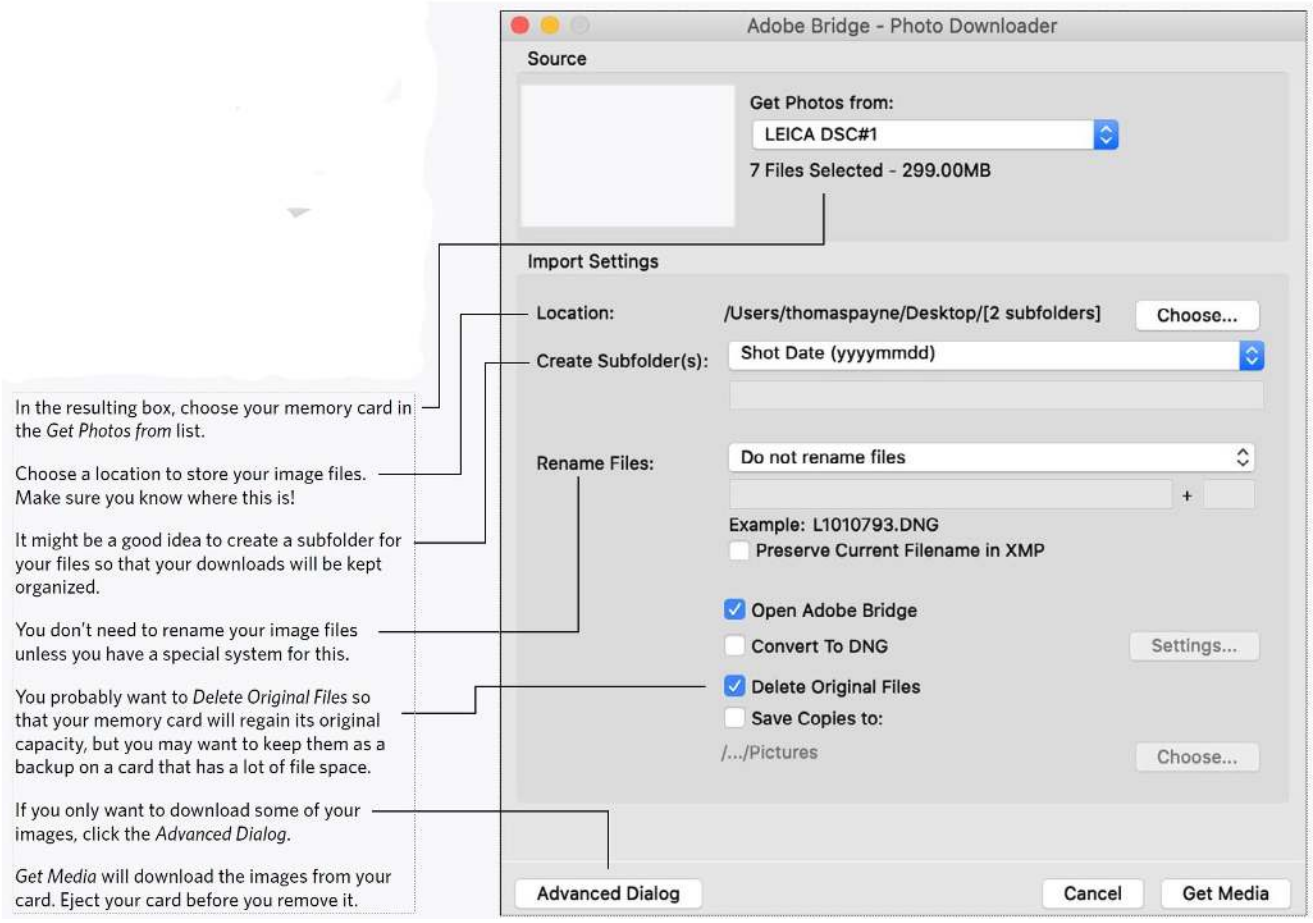
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1.2: 1CR ADOBE BRIDGE

There are many ways to get images from your camera's memory card onto the computer. Here is how you use Adobe Bridge to do this.

Once you have your card connected to the camera (using cord to camera, computer's SD slot, or card reader), open Bridge and click on the download icon (red arrow below).







Adobe Photoshop Camera Raw is a bit of a strange program—it doesn't actually change your images, but instead adds instructions to your image on how it should be changed if it is opened in Photoshop, saved as a copy, or viewed in Bridge. It does this by adding instructions to either the image itself or more commonly in a separate file called a sidecar file.

When you are done changing your image, you will click the Done button instead of saving.

One of Camera Raw's benefits is that it doesn't save the images—if you make wrong edits or completely mess up an image, you can always go back to the original, just as it came out of the camera.



At the top right of the Camera Raw window (and in the image thumbnail when it is rolled over) there is an option to save an image, but what this actually does is make a copy. Your original remains untouched. Since your adjusted RAW images cannot be opened in most applications, you might want to make a copy to send to someone (or place into another program or whatever).

Simply push on the save image icon, set the destination, give the file a name, and probably set the file format to JPEG. If you are emailing the image you can set the size as in the illustration below.



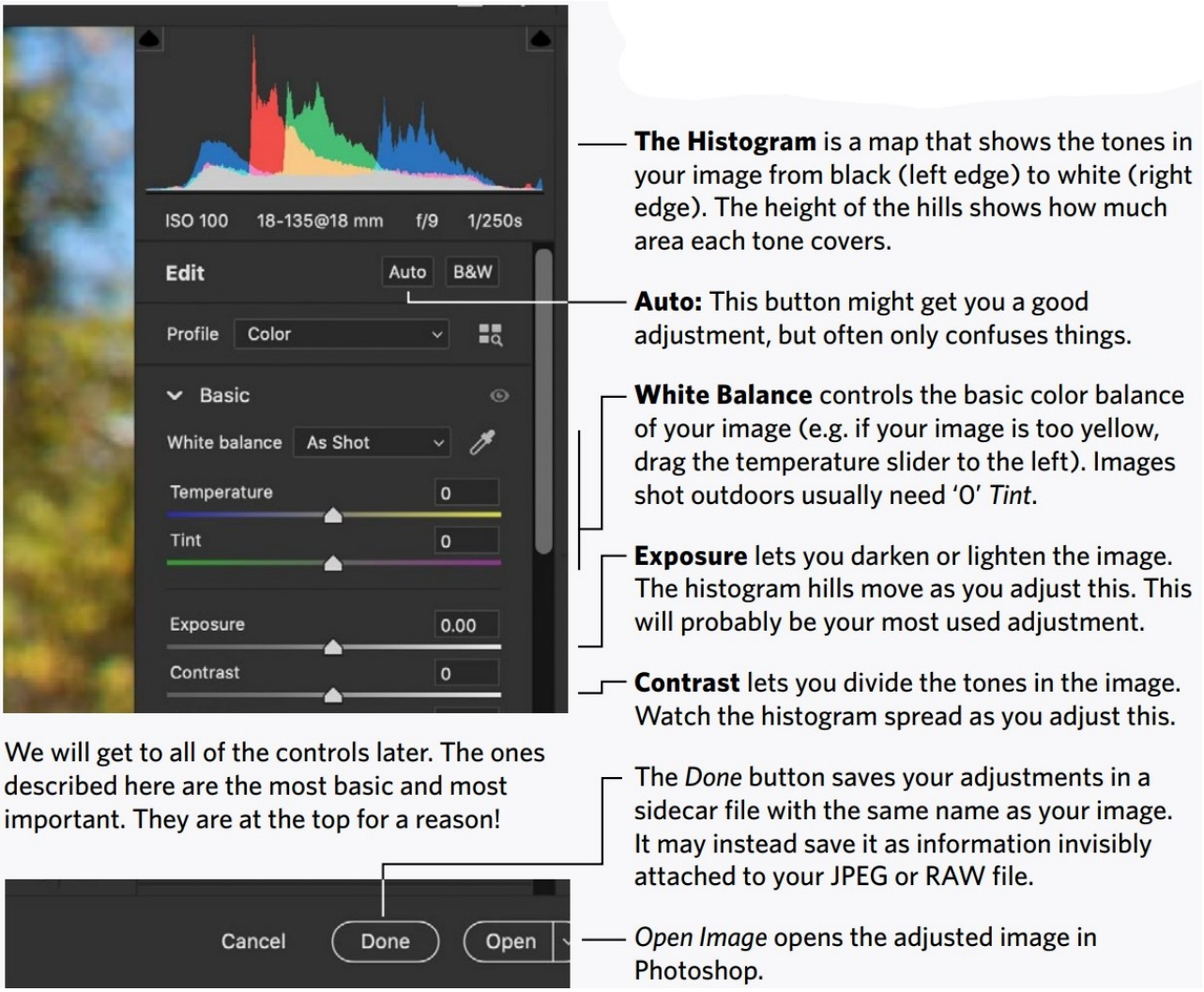


Most editing controls in Camera Raw are accessed by clicking on the Edit icon near the top right of the workspace. This brings up a panel with a series of tabs. Scroll all the way to the top of these for the Basic tab. This is by far the most used area of the application.

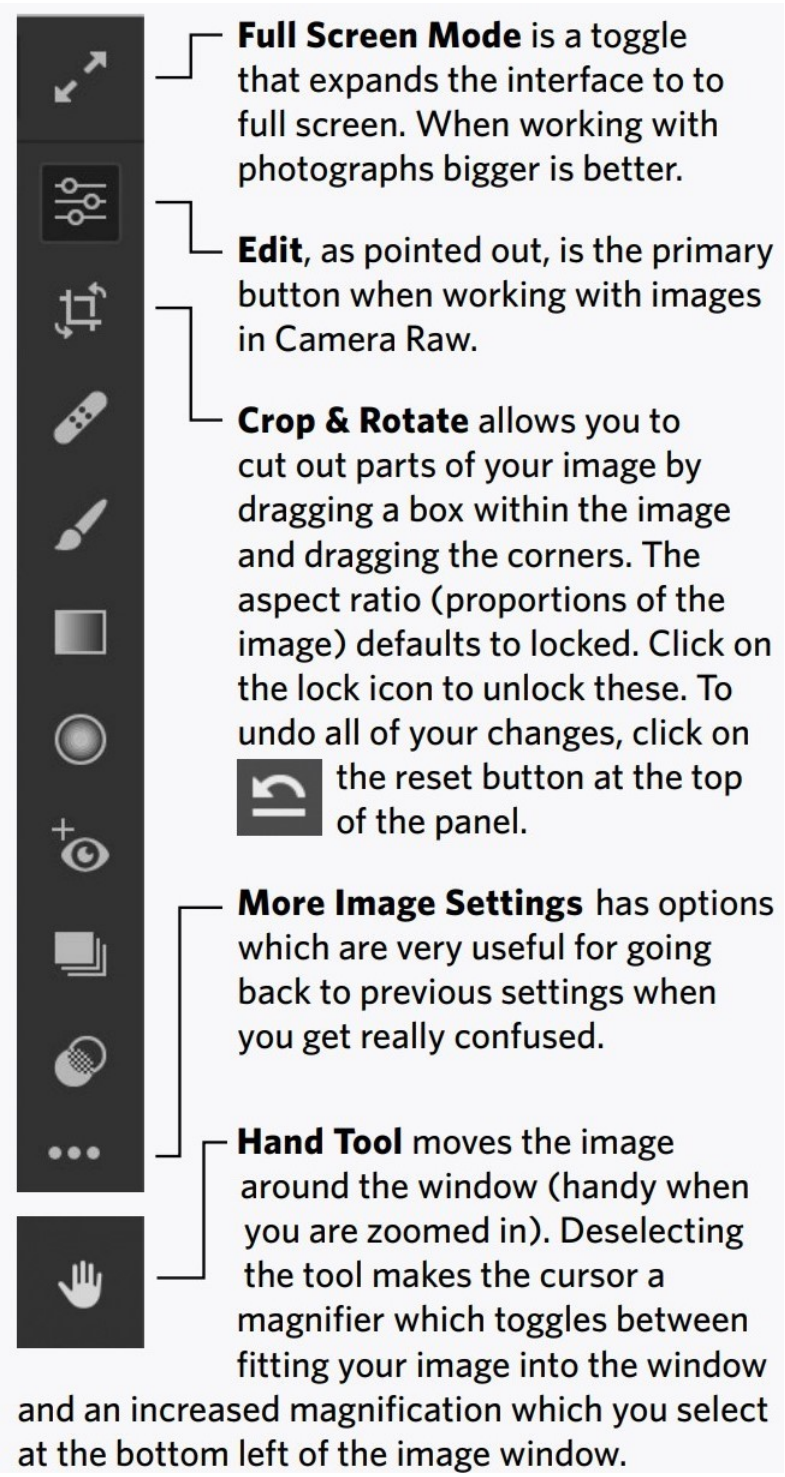
BASIC FEATURES OF CAMERA RAW

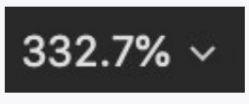
All of these adjustments should be tried on just about every image you make, even though you will probably find that some images will not benefit from any adjustments.

The adjustments not shown here are much more special-purpose, and can easily fight with each other. For now you might want to play with them, but be prepared to reset each by double-clicking on the slider pointer ( ).



Along the right side of the Camera Raw interface are the panel selector icons. Many of these will be covered later, but a few are important now.





When making adjustments, human visual memory is very bad. There are a few ways that Camera Raw can help you effectively compare changes you make.



The buttons at the lower right of the image window both illuminate after you make a change to your image. The button on the right simply allows you to toggle your adjustments on and off so that you can make sure you are making your image better.

The button on the left is a little trickier, but is well worth exploring as it activates before and after views of your image on the same screen. You can either click on this button repeatedly to get to the different comparison views or hold down and select them from the pop-up menu.



Once you activate the you can make adjustments and see the effects clearly, but some very confusing but useful new buttons appear.



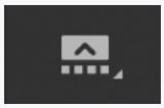
The first button is simply the same button as you pushed or chose the menu with. Yes, I know it looks different, but it is the same.



The next two buttons either exchange the before/after or send the after image to the before (respectively). For example, if you don't like all the edits you have made, you can exchange the images so that the original is the image that is now being edited. Conversely, if you like all the edits you made, you can send the after image to the before and continue to edit. Play with it.



At the top right of the image window is a gear icon that brings up the preferences for Camera Raw. You might want to see what these involve, but right now the defaults are just fine.



And finally, I am sure you would figure this out yourself, but the little button by the window magnification on the lower left hides the filmstrip, giving you more screen area for your image.



BRIDGE

After you have downloaded your images, view them in Bridge. Keep the instructions on the previous pages handy while you do this so that you can go through the options presented.

Drag the panel edges to resize them in Bridge. Sometimes you might want the preview panel to be large so you can better see the selected image or you can see several enlarged images at once. Other times it will be better to see a lot of thumbnails at once, so that window should be bigger.

Find your best images and group them together.

CAMERA RAW

Open an image in Camera Raw and poke around the window using the instructions on the previous pages. Try different things to see what happens. If you don’t like what you get (or get confused) then just hit the cancel button. You could instead hold the option key which changes the cancel button to Reset.

Try adjusting the white balance, exposure, and contrast with different images. These are the most important controls, and although not all images will need adjusting, you should get very familiar with what the changes look like.

Go ahead and try other adjustments as well, but be aware that the other adjustments can easily work against each other and most images just need the first three adjustments. Again, refrain from using the Auto button. It makes further adjustments very difficult.

COMPARE, DANG IT



It always amazes me how students will make changes to an image and then compare these changes to an image they only hold in their memories from before the changes were made. This only works for extreme adjustments, and is not good for getting the best from an image.

Instead of comparing changes you have made to an image in your memory, use the before/after buttons. Sure, these are a little hard to figure out at first, but they are important.

OH, AND ALSO

Look under your image in Camera Raw and you will see a descriptor of how the image would be sent to Photoshop.



Click on this and change the color space to the description that starts with sRGB if it is not already. More about why you want to do this is in the Color chapter. For now, just do it.

The following are questions you should ask yourself about this section of Camera Raw instructions.

CAN YOU...

Import images using Bridge and know where those images are being stored and organized?

View a set of images from within Bridge?

Drag Bridge panels and click tabs to reveal and resize windows in the work areas?

Sort your best images by dragging or rating?

Find information about your images, including the time and date they were taken?

Select multiple images to view in the preview panel or open in Camera Raw?

Export a sized JPEG image from Camera Raw?

Adjust the white balance of images in Camera Raw?

Adjust the exposure and contrast of an image?

Zoom in or out of an image to see details or entire image?

Look at different areas of an enlarged image?Crop and rotate images?

Use comparison views and move adjusted images back and forth or reset them?

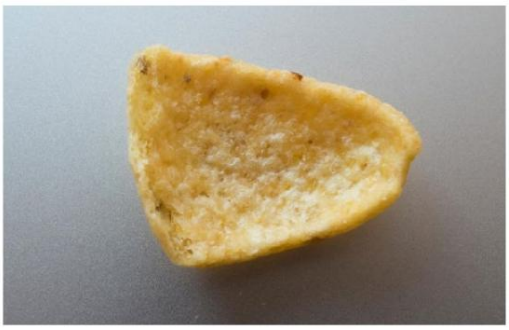
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2: Basic Camera

This chapter introduces some very basic things about cameras that will be expanded upon later. It is like learning how to drive, where it helps to know there is an engine and you have to give it fuel every once in a while.

The Sensor

At the heart of any camera is the sensor. It is a flat rectangular chip that light from the lens falls upon during exposure. It converts this light to numbers which will form an image. Like the back of your eye takes light and converts it into stuff for your brain to figure out to make vision.



Corn chip. This one is about the size of the sensor chip in a camera.

The Camera

Just as the back of your eye is pretty useless without all the paraphernalia surrounding it (front of your eye, brain), the sensor chip needs other things, which are collectively called a camera.

Kate's eye



There are two types of digital cameras that are controllable and capable of high-quality images. These are distinguished by their viewing systems. The first is a Digital Single Lens Reflex (DSLR or Digital SLR) camera. These cameras are the traditional mainstay of photographers, and they are the ubiquitous type of camera at anything from press conferences to sporting events. They are versatile and generally dependable work-horses. The basic design of DSLRs predates the advent of digital cameras by more than a half-century.

DSLR Camera Operation

With a DSLR viewing system the image from the lens (which forms the image) is reflected by a mirror up into the viewfinder. When the shutter is pressed, the mirror flips up and the image is allowed onto the sensor for the time it takes to record it. After the

image is recorded, the mirror flips back down and the image is again diverted to the viewfinder. If you have one of these cameras you can see that the instant the picture is being taken the view-finder is dark.

While this type of camera is very good, it does have some disadvantages. What if the flipping mirror could be eliminated, enabling the camera to be quieter and smaller?

Mirrorless Cameras

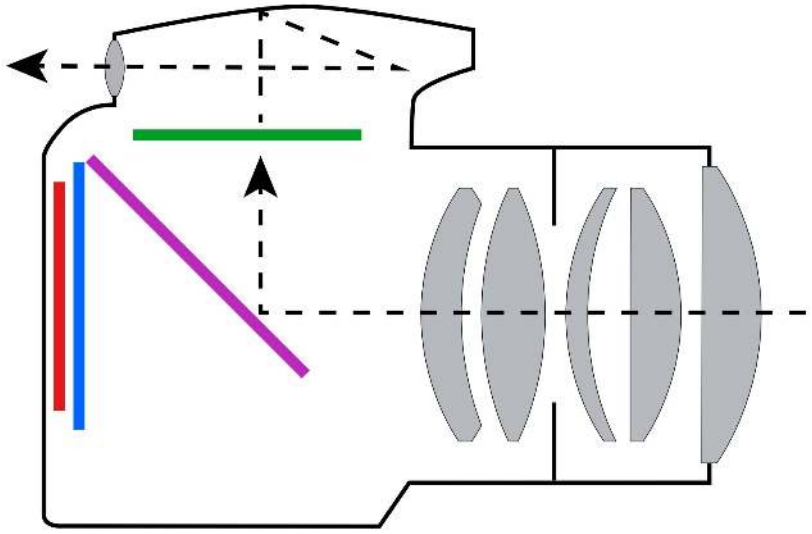
The answer is the mirrorless camera. While the name is not too imaginative, it does describe a big difference from DSLRs. These cameras, since they do not rely on a mirror, are indeed both quieter and smaller. They are also somewhat more expensive than comparable DSLRs.

With a mirrorless camera, you are viewing an image made by the sensor when you look at it in the viewfinder. When you take a picture, a shutter closes, blocking light from the sensor, then opens again to expose the sensor, which is now in shooting mode. After the exposure, the shutter closes and then opens again in viewing mode. All of this in a fraction of a second.

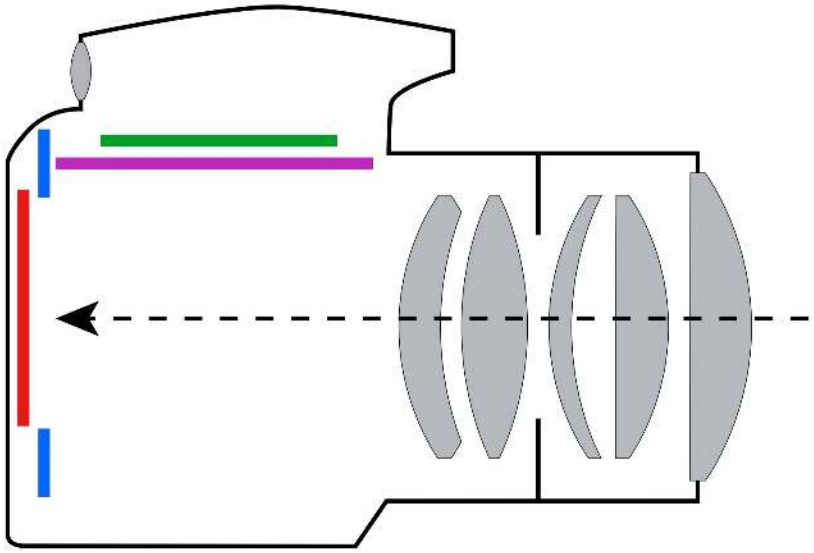
Which type of camera is best depends on the photographer. Since the mirrorless camera's viewfinder is an electronic image, the viewing is very different from viewing the optical image of a DSLR—some hate it and some like it. There are also some other

differences in these cameras, such as how the camera auto-focuses.

When viewing through your DSLR, the image comes through the lens, bounces off a **mirror**, and is projected on a **screen**. You view this optical image through a mirrored prism.

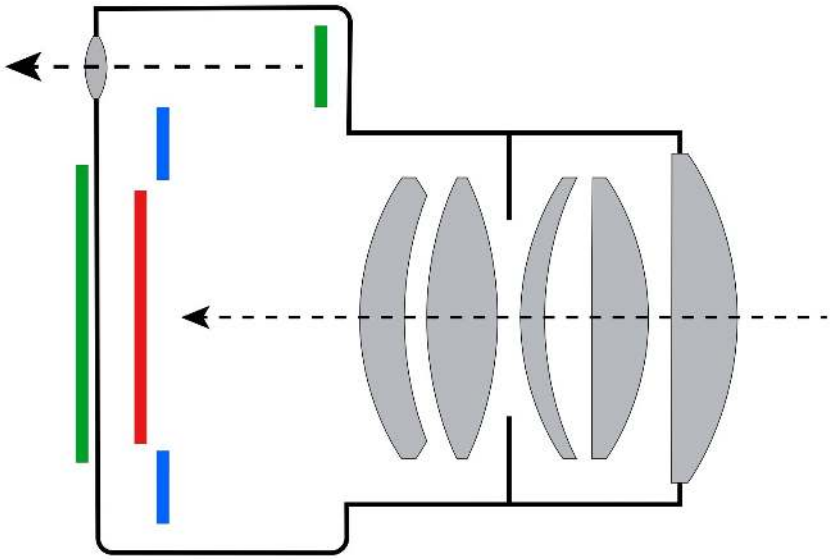


When you fully depress the shutter button, the **mirror** swings up out of the way, the **shutter** opens, and light is allowed to hit the **sensor**. In a fraction of a second after the sensor is exposed, the shutter closes and the mirror swings back down again for viewing.



A mirrorless camera in viewing mode uses the **sensor** to form an electronic image on either the **viewfinder screen** or back **viewing screen**. When the picture is taken, the **shutter** closes, the sensor switches to shooting mode, and then the shutter opens for the duration of the exposure.

Most DSLRs are also able to operate this way when using the back viewing screen.



Sensor Size

Image quality is largely governed by sensor size. Common cameras generally have what are called APS-C (or four-thirds) size sensors, while more expensive cameras generally have larger full-frame sensors. These full-frame sensors give better image quality, but they might be a waste of money since the image quality of the smaller sensor is darned good. Since the APS-C sensors are smaller, the cameras that sport them are also smaller.

Other Cameras

There are many different types of cameras designed around very small sensors. As a matter of fact, a designer can put a sensor into just about anything. Add a lens, and you have a camera. Cellphone cameras, Go-Pros, and small point & shoot cameras are just a sampling. Sensors and lenses are put in watch-bands, eyeglasses, and even digital assistants which can assess how you are dressed.

Most of these have tiny sensors. The quality of an image is directly governed by the size of the sensor, so if you want the potential for having a high-quality image, you have to use to a bigger camera. This is not to say small sensors cannot take good photographs. They can, but are very limited in how well they can in different situations and for different uses.



Arizona border patrol camera

Using Your Camera

With most DSLR and mirrorless cameras, you have the choice of composing your photograph either through the viewfinder you put up to your eye or viewing it on the back viewing screen. Which method is better largely depends on the situation and your preferences, but generally viewing through the viewfinder allows you to at least brace the camera better for potentially sharper and more carefully composed images.





Self-portrait with my wife using Duluth Harbor-Cam (overall view and detail)

Shutterless Cameras

Most cameras with very small sensors (like cellphone cameras) don't use a physical shutter, instead they just switch the sensor from viewing mode to shooting mode.

There are other advantages to using the viewfinder. The back viewing screen is one of the highest users of power in your camera, so turning it off will conserve your battery. With DSLR cameras, using the back viewing screen to compose your images switches to a slower and less precise auto-focusing method.

Holding the Camera

In situations with a lot of light, how you hold your camera doesn't matter too much as long as you can study the image carefully. But when taking photographs in lower light, the possibility of camera shake can make for some really blurry images. If you are using the viewfinder in low light, hold the camera with both hands, tuck your elbows against your body, and press the camera to

your face to steady it. Calm your breath while you squeeze the shutter button. And if it is a really low-light situation, forgo that last cup of coffee.

When using the viewing screen on the back of the camera, is more difficult to steady it, but pushing the camera away from you so that the neck-strap is tight around the back of your neck helps. Neck straps will be discussed very soon.



Cameras are right-handed. The thumb and index finger can easily reach the most used controls.
The left hand helps brace the camera by holding the lens (overhand or underhand). It can also be used to turn the zoom ring or manually focus. Any switches on or near the lens are usually designed to be reached underhand, since this way of holding usually provides the most stability.

If you really want to take photographs with very little light, look for a wall or pole to lean against. Even better, find a surface to put your camera on or hold it against.

Neck Strap

A neck strap for your camera is like a seat belt in your car. Use it. Gravity loves to eat cameras.

UV Filter

When you purchased a camera you may have been pressured to buy a clear filter to put over your lens. If you didn't buy it, consider doing so. Doorknobs seem to love my lenses, and I am sure there are many things just waiting to put a dent on the front of your lens or crash right into the glass. It is much cheaper to replace a filter than an expensive lens. These filters are called something like UV filter since it sounds better than glass filter. They do block some UV (ultraviolet) light, but then again, so does plain glass.



UV filter to protect the front of the lens

Clean your Friggin Lens

Try this simple exercise: Eat a bunch of potato chips, then put finger marks all over your glasses or sunglasses. Now see how much worse your vision is. Your camera's vision is very much like this.

All you have to do to clean your lens is fog it up with a HUH from your lungs, then with light pressure wipe it in a circular motion with a soft cotton cloth. A clean cotton shirt (not the one you were wearing when you ate all those chips) will do. For greasier situations you may need to apply a little eye-glass cleaner instead of the HUH.

Don't worry if you have a few flecks of dust on or in your lens. If it is in modest amounts it will not effect image quality.

Tripod

When you have very little light, a support better than shaky human hands is needed. Although tables, chairs, and all sorts of other things can be used to steady the camera, a tripod made for this purpose is the most versatile.



With the cameras shown here you really need a tripod to take any photographs. Smaller digital cameras still benefit from tripods in many low-light situations.

Tripods come in all sizes and at all costs, and even a very inexpensive one can get you a good photograph. If you want to use a tripod a lot, though, remember that you pretty much get what you pay for. More money means a steadier support, better durability, controls that securely lock the camera into place, and lighter weight relative to the size of the tripod.

Battery

The battery that powers your camera is pretty straightforward, but there are a couple of things you should be aware of. First, some operations on cameras (like using the LCD screen to view or review images) drain the battery fairly quickly.

Secondly, cold temperatures will not drain a battery, but will make it powerless until it is warmed up again. In the winter, consider keeping a spare battery in a warm pocket if you are outside for a while.

Rain

One of the reasons photographers buy expensive cameras is that they are often water-resistant. Each door, button, and dial has rubber grommets to protect the insides from a light rain and splashes.

Most less-expensive cameras are not waterproof at all. As your pappy (should have) told you, water and electricity don't mix, and the inside of your camera is chock full of sensitive electronics. I just found out that spilled beer is also pretty darned good at

sneaking into cameras. Keep your camera away from any liquids (beer or rain). I will try to as well.

Coated and Multi Coated glass

You may have noticed when you looked into the front of your camera lens that the reflections have colors. This is because they are exposed to metal vapors in manufacturing (either once or multiple times). Besides making funny-colored reflections, this also makes the glass surface reflect less light (so it transmits more light), which is a good thing. Some coatings also improve the scratch-resistance of the glass.

Cameras have used these coated or multi-coated lenses for more than fifty years, but eyeglasses have had the option of coating only since about the turn of this century. So the next time you are watching a movie set in 1950 and you see those colored reflections in the actors' glasses you can jump up and down and yell about how unfaithful the movie is to real life.

Since camera lenses contain many glass elements, it is a good thing that they are coated, since each piece of glass has a reflection from both the front and rear sides which can bounce back and forth between elements. With filters that go over the lens, coatings are less important since there is only one piece of glass, but you still may want to get a UV filter that is coated or multi-coated.



The same light reflected from an uncoated filter (left), a multicoated filter (center), and a more expensive multicoated filter (right). The filter on the right is ten times more expensive than the filter on the left.

Controls

Although your camera has dozens of different settings you can control, there are just four main settings on any camera that influence the interpretation of an image—focus, aperture, shutter speed, and ISO.

Focus

When you lightly push the shutter button the camera tries to find an area to focus on. When it does, it locks onto that focus (showing the area it picked in a rectangle or oval). If you lift your finger off the button, this focus is forgotten, but if you continue to press the button, the photograph is taken utilizing this focus area.

Aperture

Just like the iris of your eye, a camera has a variable size opening which controls the amount of light let through the lens. This is called the aperture. When you are using the 'P' setting on your main dial, this opening is controlled automatically by your camera according to the amount of light present in the scene.

Shutter Speed

Behind the lens, and very near to the sensor, there is a sliding curtain which controls the amount of time light is allowed to hit the sensor. This shutter governs the shutter speed. The time the shutter remains open is expressed in fractions of a second (whole seconds for long exposures). Like the aperture, the camera determines this time automatically based on the amount of light present in the scene.

ISO

The sensitivity of the sensor to light is governed by the ISO setting. The camera can set this automatically based on the amount of light present in the scene. But as mentioned before, you should have it set to ISO 400.

All Together

These four settings (three of which are for exposure) are almost always reported in the viewfinder or on the back viewing screen when you push halfway on the shutter button. They display as a group of two numbers: the first is the shutter speed (in fractions of a second), and the second is the aperture (sometimes with the letter ‘F’ before it). Separate from these, and usually labeled as such is the ISO number. The point of focus is shown as an overlay on the image itself.

Four Things

All cameras for over 150 years have had focus, aperture, shutter speed, and ISO. But they don’t always have a control for all of these things. For example, cellphone cameras have an aperture that is fixed to one setting.

The exposure controls are reported at the bottom of the viewfinder in most cameras.





A camera makes all of the exposure adjustments based on the amount of light in a scene. But it doesn’t usually make the adjustments based on the subject. The camera is basically guessing what you are taking a photograph of. When you are new to photography, this system works fairly well. But as you get more experienced, you will want to make the decisions based on how you want to interpret the subject.

The Other Settings?

But what about the other dozens of buttons and settings on your camera? These govern many things, such as the file format used (it should be RAW), or the zoom setting that allows you to bring a bear closer without actually bringing the bear closer.

These other settings are responsible for a lot of complexity in your camera. On one camera of mine there are twenty-two menu items with no less than a hundred settings that govern how the camera carries out automatic focus. Yikes! I do not know how to use them all, nor do I need to since most are for special purposes.

More Clean Lens

Camera lens optics are sensitive. Smudges on your lens sends light in unwanted directions, destroying sharp focus and increasing unwanted reflections.

As a matter of fact, an old trick that was used to blur blemishes on portraits or in movies was to put a little grease (like Vaseline) on the lens intentionally. Another trick is to place a layer of pantyhose over the lens to soften the image. You can intentionally soften the image from your cellphone camera a bit by wiping the side (outside!) of your nose (nose oil!), then smearing the lens.

Dust on a lens does not appear as specks on your image because it is so far away from the place where things are in focus that it is just a big insignificant blur.

If you see dust specks only when looking through your camera they are on the viewing screen. If you see dust specks on your images, the dust is on the sensor.



Cellphone cameras also have most of the controls this book will be investigating. To use some of them you need a special application.

In this example, aperture is missing. This is because most cellphone cameras have an aperture that is non-adjustable.

But there are still controls for focus (blue box), ISO, and shutter speed (red boxes).

Because of quality and exposure limitations, these controls are much more useful with dedicated cameras.

There are some expensive professional cameras that actually have very few settings. But all cameras dealt with in this text will have provisions for changing focus, aperture, shutter speed, and ISO.

Light Color

The type of light you use when taking photographs can make quite a difference. Avoid taking photographs using what is called mixed light. Light from different types of light sources is actually different colors, something our brain accounts for but cameras do not.

If you are taking photographs using a window for light, turn off the other lights in the room. Or, if you are taking photographs using the lights in a room, close the window curtain. Unless you are taking photographs that will be black and white, limiting the lighting to one type of source will make the color in your images much better.

Now Go Shoot

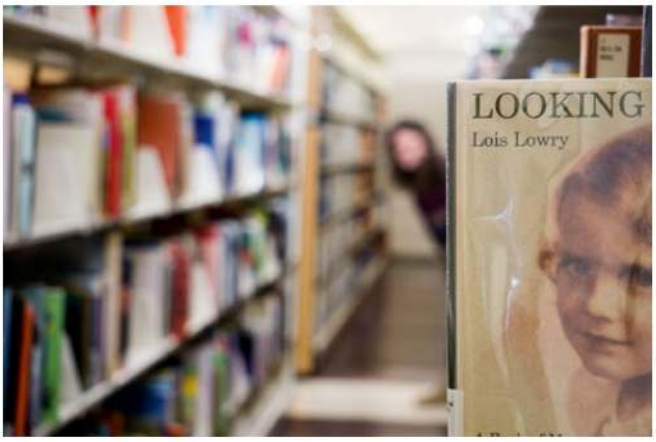
Actually, before you go shoot, study your camera. Pay attention to the things we have covered in this (and the first) chapter. I wouldn't say bond with your camera, but do give it some attention. That hunk of metal, glass, and plastic will help you express yourself.

The information in this chapter has been mostly geared towards giving you background information which you can use to increase your understanding of that thing you hold to secure images of the world. Think about what is happening when your camera is taking a photograph. It is pretty incredible.

There is also practical information you can use while shooting. Clean the lens, try different ways of holding the camera (for both vertical and horizontal compositions), and don't go out in the rain.

By just using your camera on program mode you can take wonderful pictures. Concentrate on that, but also look at those numbers (usually on the bottom of your screen) and see how they change. They are not very important now, but they will be as you learn how to better control your images.

The rest of this book will be covering many of the things in this chapter in greater detail. If you are really interested in learning about something sooner, feel free to find it using the table of contents or the term references in the appendix. Or you can search the web (of course).



Megan Stephenson



Hannah Cox

Basic Camera Questions

What device converts light levels to numbers that will form an image?

What is an advantage of a digital SLR camera compared to a mirrorless camera? A disadvantage?

Camera image quality is mostly governed by what?

What viewing method allows you to brace the camera better?Why is using a UV filter a good idea?

What device do you use to prevent camera shake?

What will make a camera battery temporarily powerless?

What is one the four main controls on a camera?

What camera part is equivalent to the iris in your eye?

What setting controls the sensitivity of the sensor to light?

What controls the amount of light getting to the sensor when you take a photograph?

What controls the time light is allowed to get to the sensor when you take a photograph?

The images on these questions pages are basically non sequiturs, but this guy is doing a much better job of bracing the camera than the guy in the last chapter questions.



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2.1: 2PH CAMERA AND SEEING

When I was in high school, I couldn't afford the camera equipment I needed. I discussed this problem with a photographer I knew. His solution to my problem was simple—just shoot using the equipment you have. Don't worry about the rest.

Instead of concentrating on what you cannot do with the camera equipment you have, concentrate on what you can do. And don't worry about what isn't around to take photographs of. Take photographs of what is around.

Related to using what is at hand—yesterday my wife showed me a photograph of a politician. It was shot from ground-level, which made it look very strange. She asked why the photographer might have shot it that way...

Let's say you are a member of the press corps following the White House. Your job is basically to take thousands of pictures of people opening and closing their mouths with practiced expressions. Think back to a time you have seen a press conference and you hear dozens of shutters firing in any given second while someone drones on about something. Do you think those photographs are interesting? No. They are mind-numbingly boring. And all of those photographs from different photographers all look pretty much the same.



Spring fern from our garden. It took 24 years for me to notice the tiny ones.

So, for a photographer to give a different take on this scenario is wholly freeing for them! An unusual photograph might also be good for the audience. It might stop the viewer and have them give the image more time. Perhaps even present the viewer with a puzzle, as it did with my wife.

So, as they say, when presented with lemons, either with your equipment or with your choice of subject, make limoncello.

The same philosophy applies to where you are. You don't have to travel to Nepal to get incredible photographs. There are things in your own environment that are picture-worthy. You might just be too familiar with them to notice.

Many great photographers have portrayed what happens to be around them. **Emmet Gowen**'s photographs of his wife Edith. **Harry Callahan**'s photographs of his wife or his landscapes around Chicago. **Imogen Cunningham** photographed plants in her home while taking care of her small children. **Vivian Maier** took photographs while being a nanny.

William Wegman has been photographing his dogs since the 1970s (remember those dogs on Sesame Street?) and **Cindy Sherman** has been photographing the most available subject—herself—for just as long. Yes, those photographs are all of her.

Laurie Simmons (whose daughter is the Girl), **Jan Groover**, and **David Levinthal** take still-lifes using common props to make social commentaries.

The point is that you can find incredible things where you are with what you have. No excuses.

> **Note**
> These introductions to photographers are categorized according to somewhat spurious criteria. The categories are really just meant to get you to start looking.
> But of course categorizing people is almost always a spurious activity.

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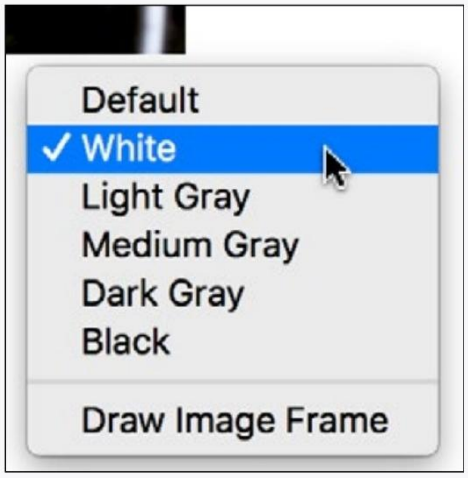
2.2: 2CR MULTIPLE EDITS

Here are two things that don't necessarily have much to do with the operation of Camera Raw, but are necessary to control your images.

Set Camera Raw Background to White

If you hold the control key and click and hold on the border of your image (you may need to reduce the magnification of your view to see the border), you will have the option to make the background white.

This is a good idea if you are going to print your image or otherwise show it on a white background in an email or on the web.

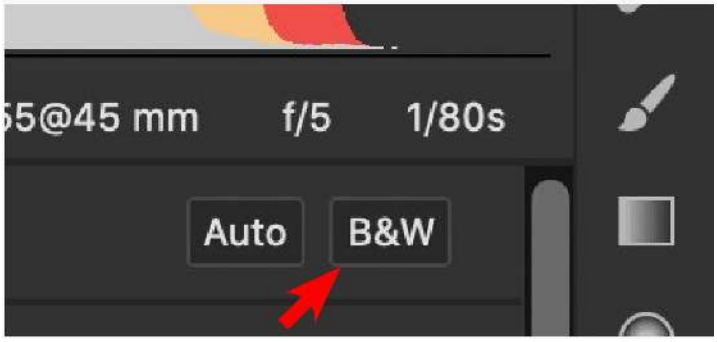


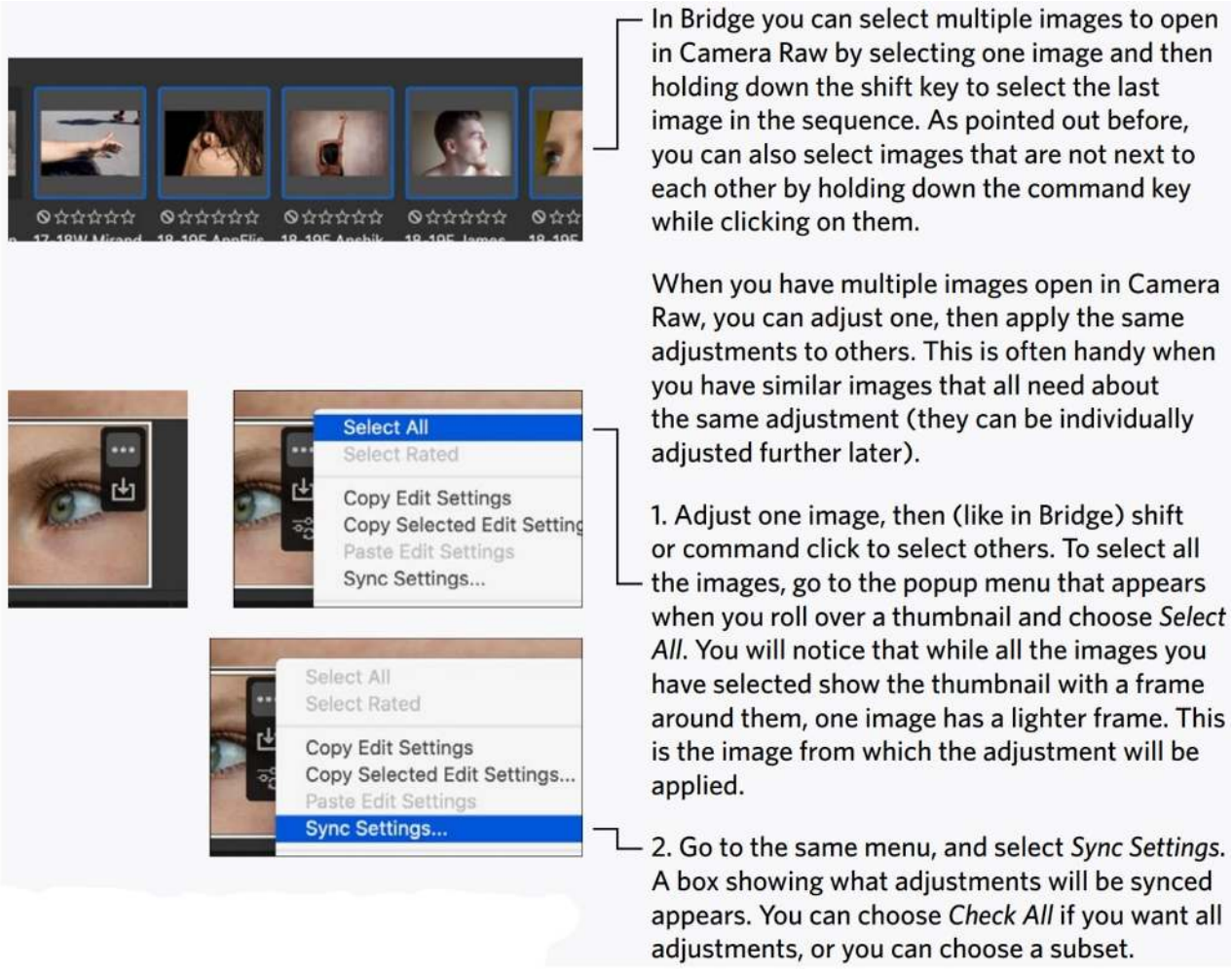
Adjust Your Display Brightness

Different computer displays have different brightnesses, and even the same display appears at different brightnesses relative to the level of room light. This is a problem, since you can correct an image to be just perfect, but change the room light or the display and the result is not perfect.

The method I use to adjust display brightness is pretty straight-forward. Simple hold a piece of white paper to the side of the display and adjust the brightness of a white area on the display to match (or make a bit brighter) than the paper.

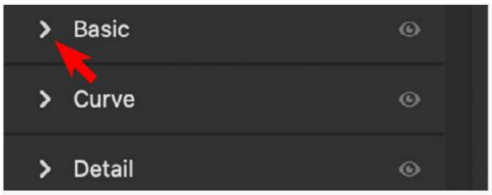
You can also apply many of the adjustments to multiple images by selecting all your images first, then applying the adjustments.



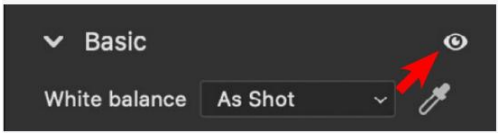


When you click Done and return to Bridge you may notice that it might take a little while to update the settings on the images there.

Try this to make all of your images black & white. This is a good way to see it working, although syncing images is usually done when you have a number of images taken in the same conditions that need the same adjustments.



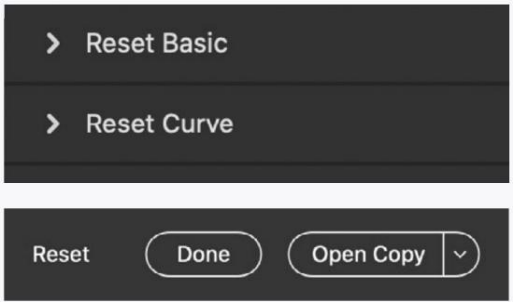
You may have noticed by now that the adjustments selection in Camera Raw has more panels than the Basic panel it defaults to. These can be shown or collapsed with the chevrons next to their title.



We will get to those other panels later, but the eyeball associated with them (arrow) is handy at this point. If you click and hold on it, the adjustments you made in the panel are hidden. Another way to compare your image edits!

Oops

If you are experimenting with Camera Raw the way you should be, you will probably get into trouble.



To reset all of the adjustments governed by a panel, hold down the option key. The panel title will change to Reset...

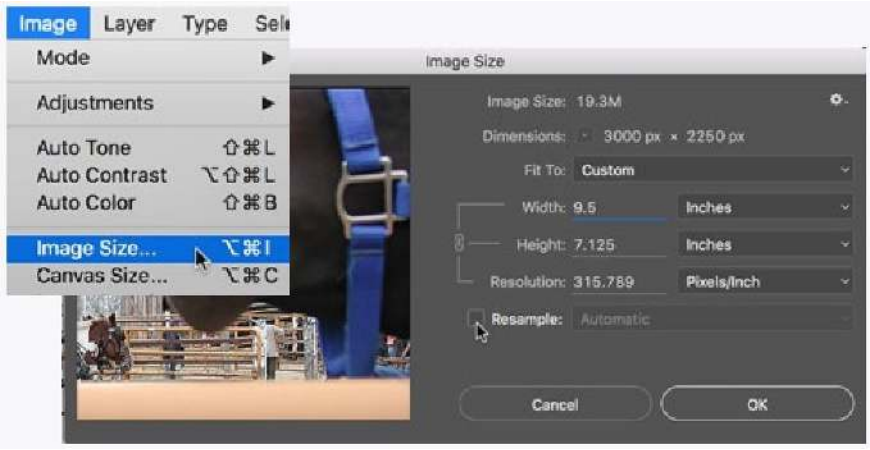
Also notice that the Cancel button at the bottom of Camera Raw will change to Reset as well when the option key is held down. This would be the equivalent to canceling out of Camera Raw and restarting it.

And lastly, single adjustments can be undone by pressing both the command and z keys at the same time. Holding down the shift key as well will redo an adjustment. You can alternate these keystoke combinations to see if that last adjustment made things better with the image or not. This method of comparing images can be used in conjunction with the multiple views covered in the last set of instructions.

Photoshop To Print

One thing you cannot do in Camera Raw is print an image. For that, you need to open your image in Photoshop by clicking Open at the bottom right of the application window.

Once in Photoshop, go to the menu Image > Image Size. In the resulting box, uncheck the Resample box if it is checked. Always make sure this is unchecked. Resample means change the quality of the image (by changing the number of pixels), and you want everything the image has.



Now enter either the Width or the Height you want your image to be on the page. Letter size is 8.5 x 11 inches, so you need something smaller if you want borders on your print. Notice that when you change one dimension (like width), the other dimension (like height) will automatically change so the image will stay in proportion (not stretch). If you happen to figure out how to unlock proportions with the chain icon, lock them back on! Also make sure the resolution of the image is over 200 pixels per inch. If it is not, then something is amiss.

Go to File > Print to print. After you are done printing, just close the image without saving it (changes were saved in Camera Raw).

FIRST THINGS FIRST

Think about this for a second: Say you have a photograph that you are viewing on a dark Camera Raw background. How are you going to know how light the lighter areas are? They may look very bright, but is that because your monitor is set to a high brightness? You can't tell. I know that because I can't either.

Set your background to white. Yes, I know it doesn't look as cool, but for any photographs that are going to be printed or shown on a lighter background, it is the easiest way to judge the tones in an image.

But what about the darker tones? Yes, you can tell how dark the darker tones are better with the background set to black. But for a variety of reasons this is less of a problem unless the final viewing situation is on a black background.

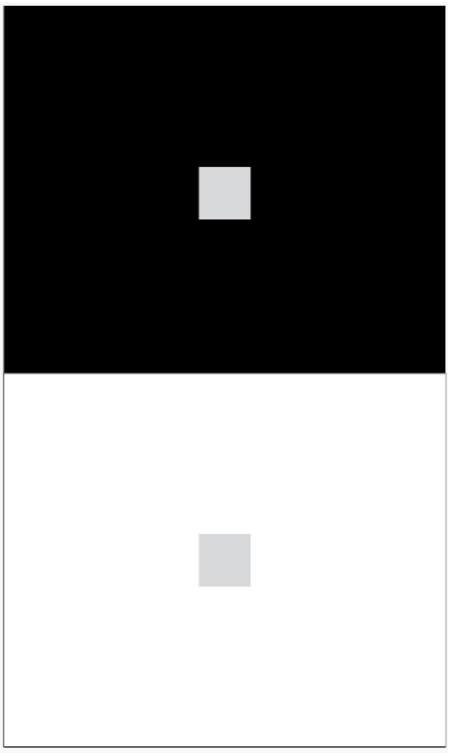
Adjust your display brightness or you may have an embarrassingly bad image when you show someone the photograph you adjusted on a display that was set too bright.

MULTIPLE IMAGE ADJUSTMENTS

Try selecting a few images in Bridge, then go through the steps of adjusting one then applying that adjustment to others.

REVIEW

Now is a good time to go back to the last chapter (1cr) and review the things there while you are sitting at the computer. These are important basic techniques that we will be building on later.



Even with all the white on this page, it is difficult to tell how dark that little square is when it is on a dark background. It is much easier to see when the same square is on a white background.
By the way, did you notice that all of the pages of this book are not actually white? Probably not, since in most PDF viewers there is nothing which to compare (key) the white.

DID YOU...

Set your Camera Raw background to white and adjust the brightness of your display?

Change the color space at the bottom of the Camera Raw window (last chapter)?

CAN YOU...

Make an adjustment to one image, then apply that adjustment to other images?

Go back to the image as it came from the camera (without adjustments)?

Use the command-z keys to toggle your last adjustment?

Open an image in Photoshop and print it?

Still do everything covered in the last Camera Raw instructions (1cr)?

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3: Lens

Since the lens does the work of forming the image, it stands to reason that it is important. Although the first part of this chapter might seem a little like inapplicable theory, it is important to know what is happening in a lens. And it really isn't difficult to understand.

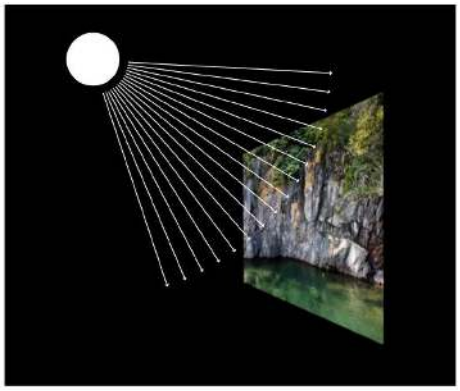
A camera lens is actually a group of lenses which together form a coherent image on the sensor. If you look into your lens you will find a group of reflections—each reflection signifies the surface of a lens element, or basically a magnifying glass. To understand how a lens works, it helps to understand the history of image-forming devices. We start at the beginning.

Pinhole Lens

Since before Ancient Rome it has been known that simply a hole in a surface can form an image. If you block all the light coming into a room, then put a small hole in a wall, an image of the outdoors will be projected on the opposite wall (illustration at far right). That hole in the wall is called a pinhole lens, and while not technically a lens (it is just a hole), it forms an image, so it is informally called a lens.

The room this pinhole uses to project the image (the Latin for room is camera) can be as large as an airplane hanger or smaller than a shoebox. You may have even made a pinhole camera by simply poking a hole in a sheet of foil to view the image of a solar eclipse.

To understand how a pinhole lens works, a few illustrations will help:

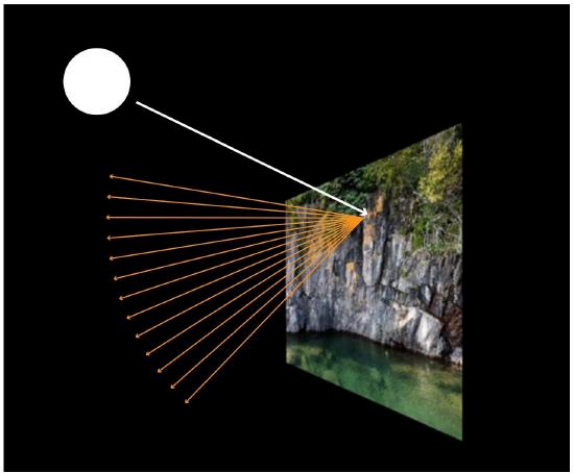


1. Above, the white circle is the sun, with light rays hitting a subject, in this case a coming off the sun in all directions, and some of them strike the cliff. There is more to light than rays, but unless you keen on the physics of light, using rays to describe light is accurate.

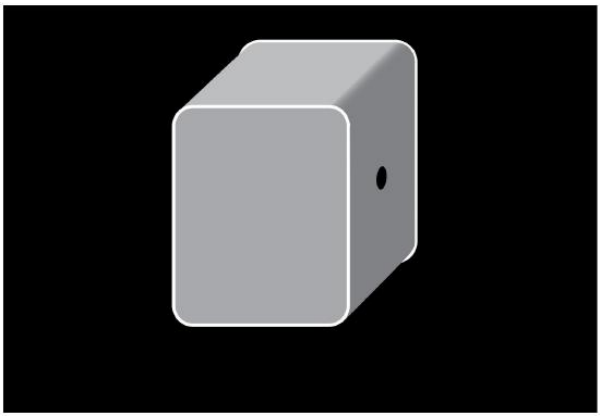


This top image is of a wall lit by a window on the opposite wall.
In the bottom image that window is covered with foil except for a penny-size hole. This pinhole forms an image of the neighbor's chimney with a pumpkin in the foreground.
This room is now a pinhole camera. The photograph of this dim image took about three minutes to expose using a digital camera.

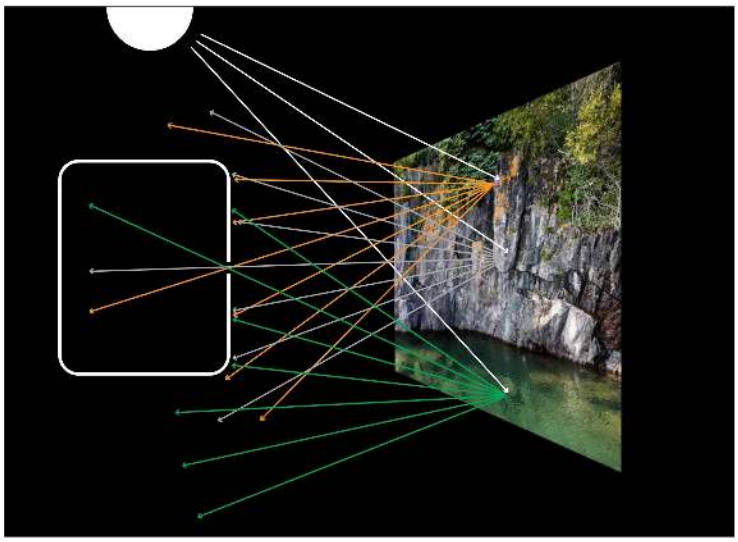




2. Turn you attention to just one ray of the sun. When it hits a colored object, it reflects only that color in all directions.



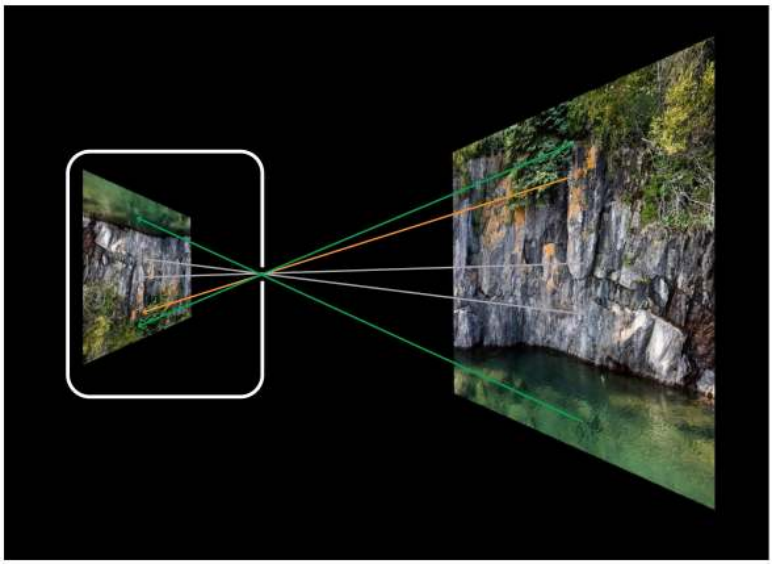
3. Somehow those light rays need to be captured. A small box with a hole in the front like the one above of it will do this. The next illustrations show a cut-away view of the box to see inside.



Cut-away view of a camera capturing light rays. The actual size of the hole needed is smaller than shown in the illustration.

4. This box is put in front of the subject as shown above. Of course there are many rays of light hitting the subject, and many rays of different colors reflecting off the subject. But only a few rays of light get into the box through the little hole in the front. Notice

how the rays from the top of the subject land lower in the box than the other rays.



5. To simplify the illustration, the parts of this phenomenon that don't matter right now are omitted and a few more light rays are shown. Imagine this with many more light rays and in three dimensions. You can see how an (upside down!) image is formed on the back of the box.
This box is a pinhole camera. All that is needed to make a photograph is something sensitive to light (like photographic film or a sensor) to record the projected image on the back of the box.

The illustration at the beginning of this chapter shows an image projected in a pinhole camera that was as big as a room (well, it was a room). The photograph at right was taken with a pinhole camera as big as a digital camera (it was one).

This pinhole photograph was made using a digital camera (5 second exposure). The pinhole used is shown in the sidebar on the next page.



There are several unique qualities of a pinhole lens. First, nothing is very sharp in the image it produces. Second, everything is in equal focus, which is called unlimited depth of field. So, an object very close to the camera will be just as in focus as an object far

away. Both of these qualities can be seen in the photograph on the preceding page.

Third, the image produced by a pinhole is very very (very) dim. If you were to project one upon your camera sensor, it would take at least a few seconds for the pinhole to let in enough light to make an image (even with a rather large hole which would make a very unsharp image).

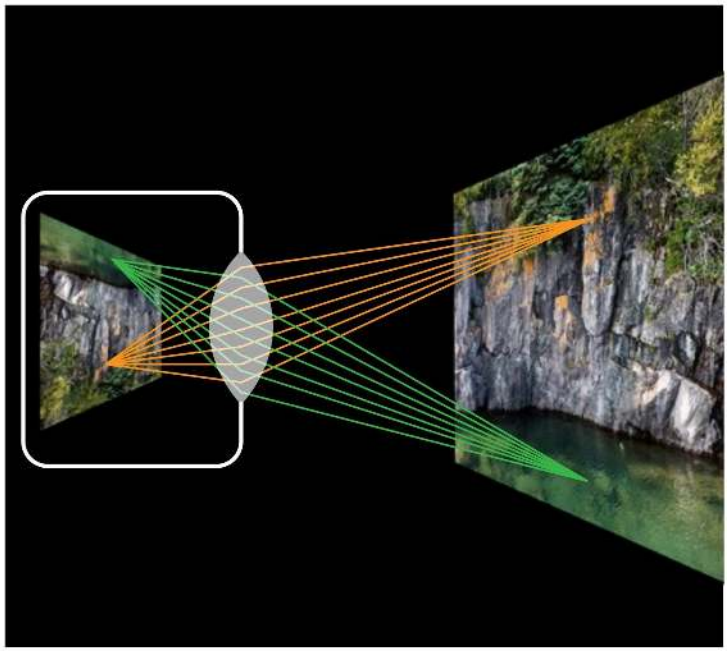
To eliminate these deficiencies, especially the lack of sharpness and brightness, a glass lens can replace the pinhole.

Simple Lens

Actual lenses are made of clear glass with two convex sides. Light rays normally travel in a straight line, but the lens bends them. Any density change will bend light rays, and glass is denser than the air around it.

Lenses are all around us, and they are similarly shaped. Examples of lenses include magnifying glasses and eye glasses. You can even see light bending from the lens of a clear glass of water.

As a matter of fact, you have a couple of lenses that you take with you everywhere you go. They bend light before it gets to the back of your eyes. Back to the camera illustrations now.



1. If the pinhole in a camera is replaced with a glass lens as illustrated above, it can gather a much greater number of light rays from each point of the subject and hence make the image much brighter. In other words, a lens is much more efficient than a

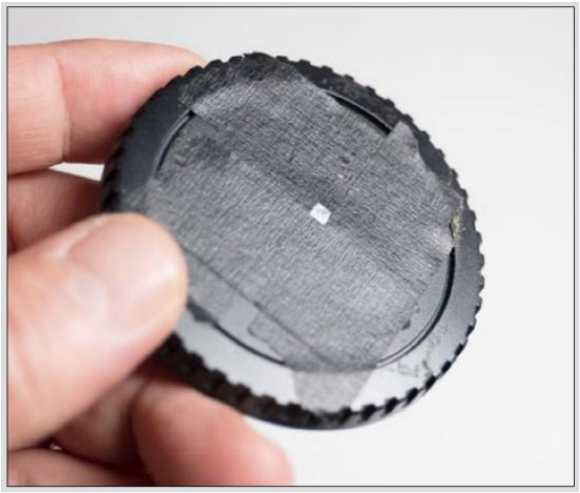
pinhole at gathering light.

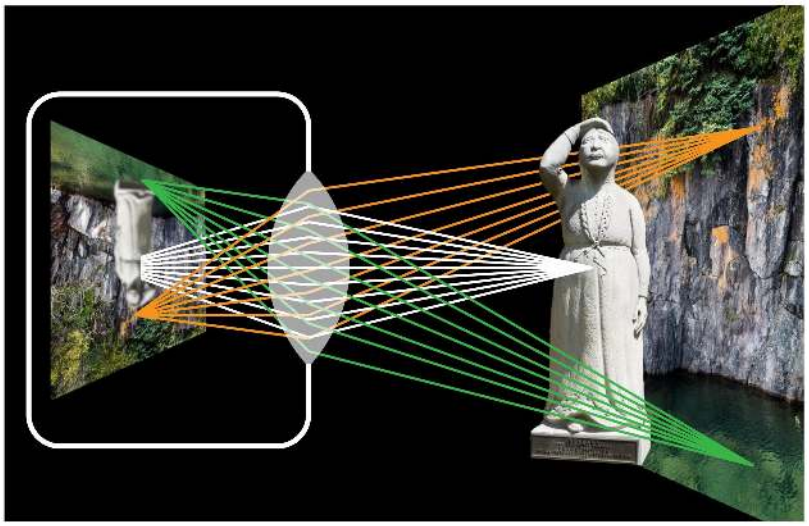


Dried lentil beans. Common lenses are the same shape, hence the name lens.

Pinhole Lens

To make a pinhole lens, take the body cap that came with your camera and drill a hole in the center. Tape some aluminum foil (thinner is better) over this hole, then with a sewing needle pierce a hole in the foil. Put this 'lens' on your camera and go take pictures!





While the background of the image is sharp, the closer statue (depicted with white light rays) is sharp at a point past the sensor (notice that the white lines do not come to a point on the sensor).

Moving the sensor back would make the statue sharp, but of course the background would then be blurry since the other rays will be past their points of focus.

2. One problem (above) that comes with using a lens instead of a pinhole is that everything is no longer in equal focus. Lenses bend light coming from a single point in the environment and then focus it on a single point in the camera. If the sensor is either in front or in back of that focused point of light, things will appear blurry.
This is why camera lenses must be focused. Focusing a camera lens is simply changing the distance from the lens to the sensor. Another way of thinking about it is moving the sensor back and forth to find the spot where those light rays come to a focused point.

This single lens, called a simple lens, is better than pinhole lens, but it still has its faults, for example: light of different colors focus

at slightly different points, and points of focus are not equal across the entire sensor area.



A magnifying glass is a good example of a simple lens. All you need to reproduce this example is a magnifier and a sheet of paper.

Cat photographed using a simple lens. In this case the lens is a magnifying glass taped to the front of the camera. It is shown in the sidebar on the next page.



Bad Lenses

In the discussion on lenses, optically precise lenses are defined as better. This is an oversimplification. Sometimes the best lens for what you are doing is not optically precise. You can buy imprecise lenses (such as a LensBaby Spark, which is less than a hundred dollars) or you can easily make one yourself. For the picture of the cat on the preceding page, ten minutes was spent making the lens from a kitchen wrap tube, body cap, magnifying lens, and plenty of tape. And more tape to make a focus mechanism (a pull-tab). Not every magnifying glass comes into focus at the same distance, so this could present a construction problem.



Complex Lens

For lens designers, the solution to the problems inherent in a simple lens is to stack several lenses together to form groups of lenses. Used in all modern cameras, these complex lenses are composed of several lenses, but function as one lens. This is why you see multiple reflections as you look into your lens. It is like correcting the lenses of your eyes with the additional lenses in glasses.

While the optical quality of a lens is important, there are also other factors which govern the cost of a lens. Some lenses are built to withstand rugged use and some are built to withstand rain. Very expensive lenses are individually tested to ensure their quality.

Image Stabilization

Everybody moves constantly, even if they are not shaky people. When you are holding your camera still, it is actually always moving along with small movements your body makes.

Many lenses now have image stabilizers that can be turned on or off. Image Stabilization (IS) is also called other things, such as Vibration Reduction (VR). Stabilization involves a lens element (or lens group) that floats to oppose small movements the camera makes as it is held.

Each reflection in a complex lens is the surface of a simple lens.





You can verify that this works by looking through your camera with the shutter button lightly pressed. Hold your camera so that something very distinct is near the edge of the frame. Try this with image stabilization off, then on. You should notice a big difference in movement through the viewfinder. Image stabilization will not help sharpness with a subject that is moving, but it will help with camera movement that may cause unsharp images.

Always leave IS (or VR or OS or whatever it is called) on... unless you are taking photographs using a tripod or other sturdy support. In that case, any movement of the floating lens element can actually cause blur.



Like all modern cameras, cellphone cameras use complex lenses.
For this photograph of a fountain pen nib, one extra lens was added to the cellphone lens in the form of a drop of water.
This new lens design allows very close images with (of course) a loss of sharpness.
You can easily reproduce this example yourself.

Lens Shape

Lenses shaped like lentil beans are called bi-convex, since both (bi) sides bulge out (convex). Lens sides that are flat are called plano, and lenses that are curved in are called concave. So, a plano-concave lens would be one where one side is flat and the other side is curved in.
Aspheric lens elements have a curved surface in which the angle of the curve changes over the surface of the lens. Lenses designed with these can get expensive.
Complex lenses use different types of elements to correct image flaws. Lens design often takes many things under consideration, such as the potential use for the lens (such as how much light it needs to gather) and how much it costs to build.

Focus

Cameras used to be focused by moving the lens in and out wtih a threaded ring. Now cameras have autofocus which does this automatically. You can still switch your camera to manual focus and turn a ring on the lens to focus, but with newer viewing systems it can be difficult to see exactly what is in focus.

As mentioned before, lightly pushing the shutter button on your camera activates the automatic focusing mechanism. When your camera finds something to focus on, it locks in that distance until you release the button or take the picture. If lightly holding the shutter down doesn't lock the focus, you should search your camera instructions for the way to disable continuous focus.

The most important thing to understand about focusing is that it is achieved at a given distance. So, if you focus on something ten feet away, lock your focus by continuing to lightly hold the shutter button, then point at different things, any of those things that are ten feet away will be in focus when you take the picture.

So, if you want something behind a close object to be in focus, you need to focus on something further away by turning your camera away. You then lock your focus by continuously holding the shutter button lightly down. Now turn your camera back and compose and shoot the scene without letting up on the shutter button. For some people it is a little awkward to keep the button lightly held.



Knute in Knorway. The focus was locked at about 30 feet (by keeping the shutter lightly pressed), then the subject was reframed and taken before letting up on the shutter button.

Eyes

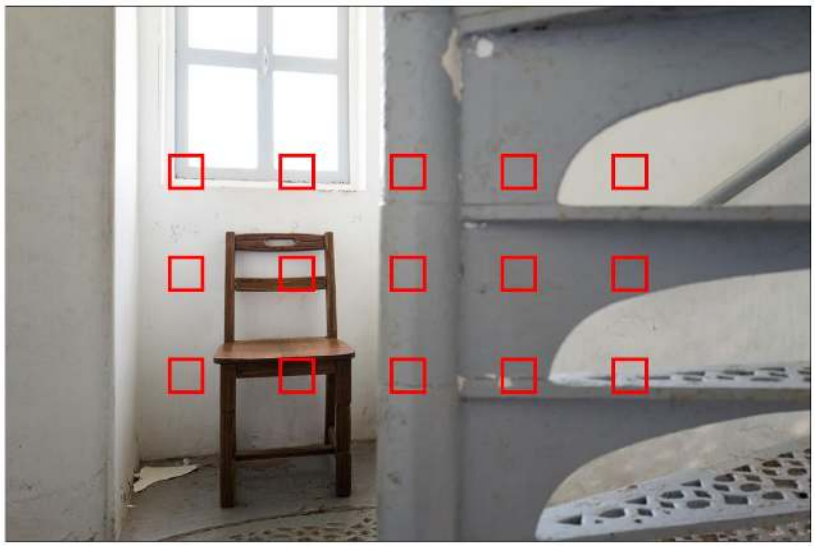
The lenses of your eyes are very much like camera lenses, and you are already familiar with their convex shape (at least on the outside!).
The image from that lens is projected onto to back of your eye (the retina) to form an image which is sent to your brain. So, your eye is just like a little camera. The image is even upside down (our brain flips it back).
Focus with your eyes is done a bit differently than with a camera lens. Instead of the lens moving back and forth, muscles bend the lens to bring the light rays into focus. A camera lens could also focus that way if were made of a flexible substance instead of glass.
Speaking of flexible substances, the lenses of eyes start losing their flexibility when they are somewhere around forty years old. At that point additional lenses (glasses) are needed to help bring the light rays to a point on the retina.

It may be easier to instead focus on something the same distance from you as what you want in focus, then temporarily lock that focus by switching to manual focus (using a switch on or near the lens).

Focus Areas

When you use automatic focus and your camera finds something to focus on, a rectangle or oval appears (or changes color) over what it found. This shape represents a focus area. There are a number of these in different places in the viewfinder, and they generally fill a large portion of the frame. Your camera will focus on the closest object that corresponds with a focus area.

But what if you want to focus on something that is not the closest to you? You can use the preceding technique, but often it is difficult to keep the focus areas from finding closer objects and focusing on them. Even cellphone cameras allow you to manually pick an object to focus on.



Camera frame showing typical focus areas. With all the spots activated (the default for most cameras), the camera would not let you focus on the chair since the stairs are closer. With only the center focusing area activated you can focus on the chair, lock the focus, then move the camera slightly to frame it.





Cameras let you specify that only the center focus spot activates.

With DSLR and mirrorless cameras, there are workarounds to let you pick different areas to focus with, but this is the best solution: In your camera's menus, turn off all of the focus areas except for the one in the center. How you do this varies with different cameras, so you may need to refer to your camera instructions.

Using only the center focus area makes focusing and framing a two-step process, but gives you the control you need. The first step is to center the area in the scene you want in focus, then lightly hold down the shutter button. The second step is to compose the image with the shutter still held lightly down as discussed before. Often this does not involve moving the camera at all between the focus and the shoot, and it will make focusing much easier, more precise, and more controllable.

Finding Focus

Different cameras find a point to focus on at different speeds. Newer cameras are much faster at focusing than older cameras, and mirrorless cameras are generally slower, although some of the newer ones are so fast you would never notice. DSLRs focus faster when you use the viewfinder instead of the viewing screen.

All cameras have problems focusing in low light situations. Many have a small light built in to help them focus closer objects by shining a light on the objects.

Cameras also have a difficult time focusing on areas in which there is no clearly defined detail in a focus area, such as the photograph below. In situations such as this you can aim at something with hard-edge detail to use as a point to focus on. Anything is easier for the camera to focus on than a bare wall or an even sky.

With this scene the the light fixture in the lower left was focused on and the focus was locked. The image was then composed and shot.



Infinity and Before

As objects get farther from the camera, eventually everything is in focus at the same time. This distance this happens at is called infinity, and is designated with an sideways figure eight (∞) on lenses that have a focus scale. This distance changes with different zoom settings or lenses.

As you focus closer on closer objects, less and less is in focus at different distances and careful focusing becomes more important.

At very close distances careful focus is crucial since very little is in focus. This can be seen in the image below where even the end of fly's legs are out of focus.



Temporary pet. When taking very close images it is sometimes easier to set the focus manually, then move the camera back and forth to finely focus.



With the lens that was used to take this image infinity is at about 15 feet, so all of the people in the photograph are in focus. In other words, all of these people are optically the same distance away since they are all farther away than 15 feet.
If the lens was instead focused at a distance before infinity, perhaps on something 3 feet away, all the people here would be out of focus the same amount. Below is a lens in which infinity lies farther—beyond 50 feet (15 meters) in this case. Your lens may not have a distance scale such as this, but it works the same way.



Other Lenses

There are many special purpose lenses. To give you an idea, here are a few examples:

A fish-eye lens is traditionally a lens than is so wide angle (180 degrees or more) that is difficult not to get your feet in the frame.

Close-up or macro lenses (not to be confused with the macro setting on some lenses) have much better overall focus for close-up photography and also excel in getting all parts of a flat subject (such as copies of paintings or paperwork) sharp. Some macro lenses also allow you to enlarge very small subjects.



RaeAnna Zinniel. Many modern lenses get as close as in this image without needing a macro lens. Macro lenses allow you to get even closer.

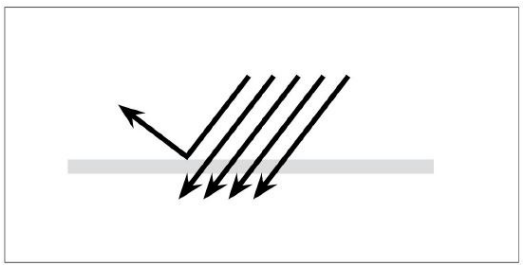
Fast lenses are ones capable of letting a lot of light through the lens. These may be big and heavy with large lens elements and prices to match.

Telephoto lenses make distant things appear closer. As with most things here, fast lenses and telephotos will be described in more detail later in this text.

Flair

When light hits any glass surface, a large percentage of that light is transmitted through the glass, and bent according to the curvature of the glass. But a certain percentage of the light is reflected back from the surface of the glass. You have seen the light reflecting back if you have ever seen a reflection on a window.

The light that is transmitted through a camera lens (instead of reflected) is what makes the image. The light that is reflected from all those elements in your lens just bounces willy-nilly around in there and obscures the image with lower contrast (haziness) and various kinds of repeating spots.

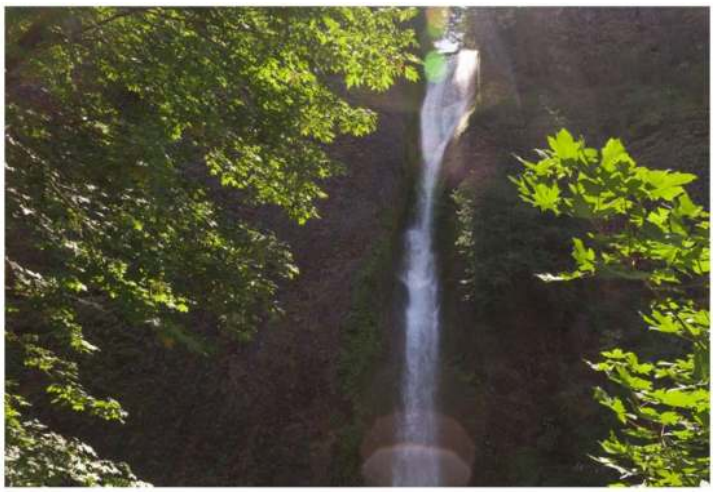


Any surface reflects light. Clear substances, like glass, transmit (let through) most light, but still reflects a portion of that light.

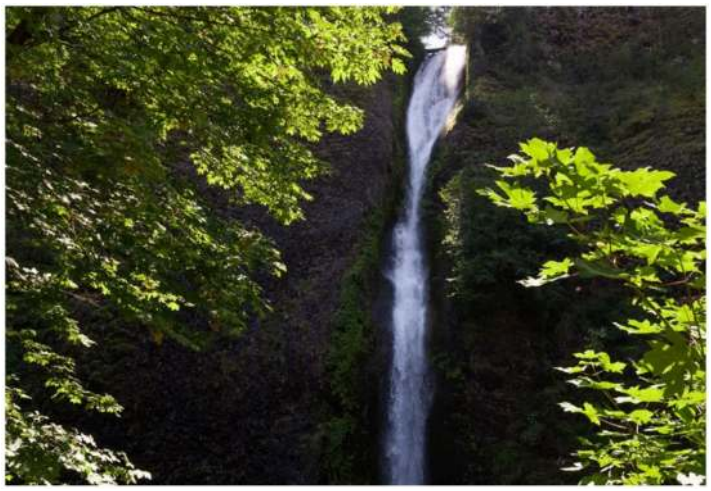
Lenses are coated to keep these reflections to an unnoticeable level, but what if a very bright subject, like the sun, hits the lens? Marauders take over your lens, and you will see lower contrast (think driving into the sun with a dirty windshield), and probably circular or funny-shaped spots radiating from the sun. Both of these things are symptoms of flair.

If the sun (or bright light) is in your image or very close to it, about all you can do to minimize flair is have a very clean lens. And then decide that those flair spots are actually kind of cool.





Flair (spots and reduction of contrast) caused by sun hitting the lens.



Here the lens was shaded from the sun. Notice the absence of the two symptoms of flair that are visible in the image above.

But if the sun is hitting your lens from outside the image area, you can (and in most instances should) do something about it. The cure is basically a baseball cap for your lens. This is called a lens hood, and it shades the lens from light much the same way a visor does for those two lenses in your head.

A lens hood will make your lens a bit longer, and can get in the way, so I wouldn't blame you for leaving yours at home sometimes. If you do, and you are pointed into the sun, you can shade the lens the same way as you do your eyes when you forget your hat.

Just hold your hand over and in front of the lens so that it shades the sun from it. You will see the flair being reduced as you do this. Your images will be free of the flair spots and the contrast will be crisp.



This lens hood has holes in the back corners where the sun does not need shading.
Lens hoods also help keep your fingerprints off the lens and offer some protection against accidental collisions.



Reflections

We are not in the habit of thinking that an image reflecting is just another way of saying light reflecting. But that is just what it is. In this image, the light rays from the sky and clouds are mostly going through the water to illuminate the depths, but part of that light is reflecting off the surface of the water and straight into the lens used to make this image. That is why you see the reflected set of clouds and why the water is so blue.
Any surface is reflective, but some scatter light more, making them less reflective. So a mirror is very reflective, not scattering light at all, and an apple is less reflective, scattering most of the light that hits it.

Now Go Shoot

Before you actually go interpret the world around you with a camera, turn off all of your focus areas except the one in the middle. While this might feel like climbing out of an fighter jet and into a Buick, it will help you intentionally focus. If you find that for some reason you hate using the middle focus area you can always change it back later.

While you are photographing, think about the lens and see how it focuses. Try taking some photographs out of focus. Try including things very close and very far away in one image. Try using manual focus. Practice locking your focus and then composing the image.

See how close your camera will allow you to focus. Does this change with the zoom setting?

Look at reflections. Look at where the light is coming from in relation to the subject and the camera. Take some images with the light behind you and then some pointing into the light. What is the difference? Look for signs of flair if you are pointing near the light (both spots and reduction of contrast). Can you get rid of it? Do you want flair?

EXPERIMENT

One of the best ways of examining controls on your camera is to do some small and easy experiments such as these at the end of most chapters in this text.

For this experiment, take two photographs of exactly the same subject and framing. Find a scene in which something in the frame is close to the camera and another thing is farther away.

In one image the foreground object should be in focus, and in the other the background object should be. This can be done by locking your focus as described.

The foreground should be close enough for you to see the difference. With some cameras this may mean getting very close to the foreground object.

What this experiment should do is familiarize you with focusing on different things using auto-focus. It should also very clearly show you the control you have with intentional focus.

What you are really after here is learning how to use focus, so the quality of the image doesn’t really matter.

But don’t just stop trying this after the experiment. Intentionally focus all your photographs.

Haley Flores, background and then foreground in focus







TOP Mackenzy Voltmer BOTTOM Camel or goat focus decisions

Lens Questions

Since when has the pinhole lens been known (very approximately)?

How big is a pinhole camera? (trick question)

What is one potential advantage of a pinhole lens? A disadvantage?

What object has the capability of bending light?

What does moving a lens back and forth relative to the sensor do?

What is a disadvantage of a simple lens?

What kind of lens is used in all modern cameras?

What is a lens made up of several lenses (lens elements) called?

What camera feature helps minimize blur from a shaking camera?

Which button is lightly pressed to activate automatic focus on a camera?

How do you lock a focusing distance using automatic focus?What focus area setting gives you the most versatility?

What should you focus on when your camera cannot find focus?What is the distance at which one focus will cover any distance? How many feet away is infinity? (trick question)

What type of lens is capable of letting in a lot of light?

What are two ways flair can be seen in photographs?

What device minimizes flair?



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3.1: 3PH REJECTING REALITY

I have been taking photographs since I was knee-high to a grasshopper. I wouldn't say it is my passion (that term seems more fitting for relationships with people), but I do like it quite a bit. This does not make me a good photographer. Perhaps it even makes me worse. I am easily amused with images. Cheap thrills.

So, of course I have thought about what draws me to photographs, and although there are many things, one stands out. I get to make my own reality. As misquoted from Mythbusters: I reject your reality and replace it with my own.

And that is a large part of what photography does—it gives a person the ability to reinterpret or reinvent the world as they see fit. In this way, photography shares a lot with the realities of books, movies, paintings, and mental quirks.

Making your own reality is a pretty powerful ability. Over the years various people have noticed that their religions don't necessarily condone the practice. The iconoclasts (destroyers of images) rise against the iconofiles (lover of images), and fatwas and edicts ensue. And then it blows over. People need other realities.

In reality everyone redefines reality in many ways (I intended both of those realities in that sentence), and photography is only one of many outlets. This is what you get to do as a photographer (someone with a camera in their hand). You can interpret the things around you however you want. You can make a world of beauty and peace. Or an ugly savage world. Or a world that is much more indefinable and unique to you.



Sculptor Alfred Seland's interpretation of the reality of a man and woman in high society. This is an artist's reality that is familiar throughout the history of art.

You don't have to think about this—as soon as you push that shutter button you are making a reality. On one level, everyone knows this—perhaps someone you are photographing puts on their photo face, or gets nervous when you take a photograph of them. There is always a chance that your reality and their reality will clash. That photograph might not look at all like who they think they look like (their reality).

Of course, not every photograph you take fits into the reality you want. You can either delete these mistakes or try to figure out if your subconscious or the universe has its own ideas of what reality you should have. A common convention in some countries is to spread your arms wide when getting your photograph taken in front of something. My wife did this once. Her place in my world just didn't extend that far, and so I deleted the image. No regrets—if the universe wanted me to have that photograph, then I defy the universe!

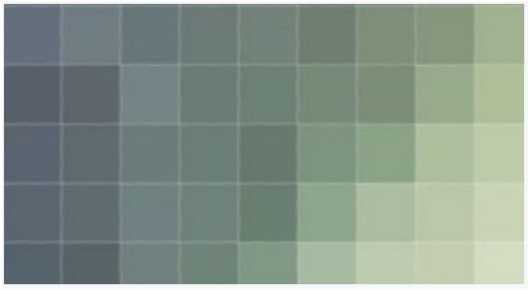
Photographers have been creating their own worlds and sharing them with others for a long time. **Elliot Erwitt's** world is full of coincidences that are humorous but faintly disturbing. **Diane Arbus'** world includes people we don't normally see in images, but whom she thought of as heroes. **Edward Weston** is a slave to a world of beauty. **Sally Mann's** children live in a world of... well, not in the world of cute innocence we normally associate with children. **Robert Mapplethorp's** world is darkly beautiful and filled with sex. Both **Ralph Eugene Meatyard** and **Joel Peter Witkin's** realities are also very dark.



As the viewer turns the corner the sculptor's intention shifts into a new reality—one in which the woman has a secret lover.
Knowing that the statue is called Albertine shifts the reality once again. The statue is actually of a prostitute with her pimp on the left and customer on the right.

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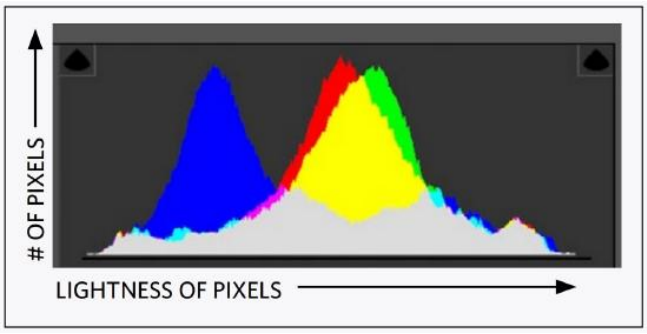
3.2: 3CR HISTOGRAM



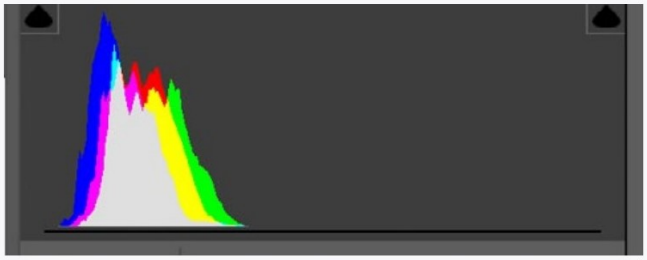
Every digital photograph is made up small squares called pixels (a shortening of picture elements). You don't normally see these because they are too small in most viewing situations. Each of these pixels is only one color. When there are enough of them (they are small enough) your eyes see these not as squares, but as continuous tone and color.

When editing photographs individual pixels don't matter much, but how the pixels work together does matter.

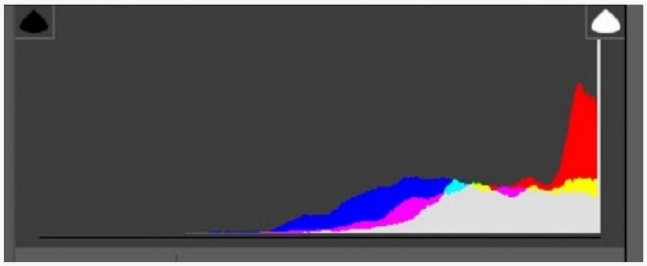
The histogram is a map that shows the pixels working together. The number of pixels of a certain tone give the hills height, and the tone of the pixels give it width, with the darker pixels on the left and lighter on the right. It is an essential tool that shows us another perspective and can illuminate problems with images.



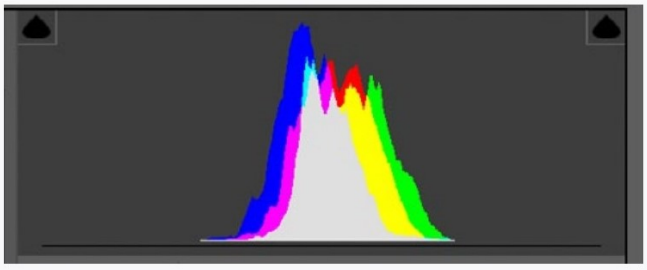
The Camera Raw histogram shows the levels of each of the three primary colors of the pixels.
Proof of how important histograms are is the fact that you see them in any image editing application, and even as a display option on your camera.



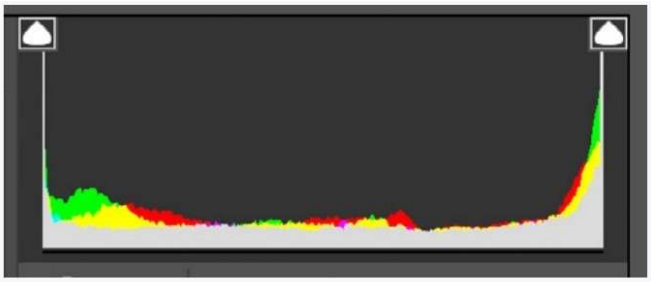
Underexposure. The histogram indicates the exposure of the image likely needs to be increased.



Overexposure. The histogram indicates the exposure likely needs to be decreased.



This histogram shows no darks or light tones, perhaps indicating that more contrast is needed.



Finally, an image with too much contrast, as evidenced by the *clipping* of tones at either end of the histogram.



The Camera Raw histogram also has two **buttons** in the top corners that light up when there are tones that fall outside of the the range of tones that make up the image.



You can click these buttons to toggle *shadow* or *highlight clipping*. An outlined box indicates they are on as in the top illustration. When these are on, the areas of your actual image that are either completely white or completely black will be highlighted with a solid color (blue for shadow clipping and red for highlight clipping).

Good photographs can be very dark, very light, or have a lot of clipping. But the histogram helps you to be intentional about what you are doing.

Before adjusting the following options in Camera Raw first adjust White Balance, Exposure, and Contrast.

Here is when you adjust the others:

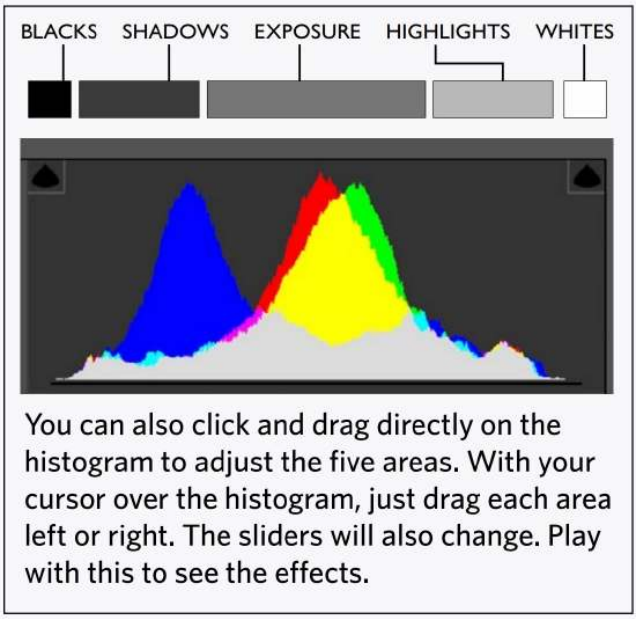
Highlights

These are the lighter tones (or colors) in an image. After you adjust the brightness and contrast, sometimes you will find that the lighter areas in the image are too light and so without detail. Bringing down the highlights will correct for this.

Shadows

These are the darker tones (or colors) in an image. If they are too dark without detail, you can lighten them to correct for this.

Less often with both highlights and shadows, you may need to adjust the other way. Such as if the highlights are too dark or the shadows too light.



Whites

These are the very light areas of the image. Be careful adjusting these since all of the spark of an image can be dulled with too low a setting and all detail lost with too high of a setting.

Blacks

The very darkest tones. Making them too light will render the darkest areas gray and muddy, so be careful with this adjustment also.

Texture

The edges of small repeating details are sharpened to enhance the impression of texture.

Clarity

Clarity is like contrast, but works at a more detailed level. As with all the adjustments, try the extremes to see what they do.

Dehaze

Try it on a landscape with distant areas.

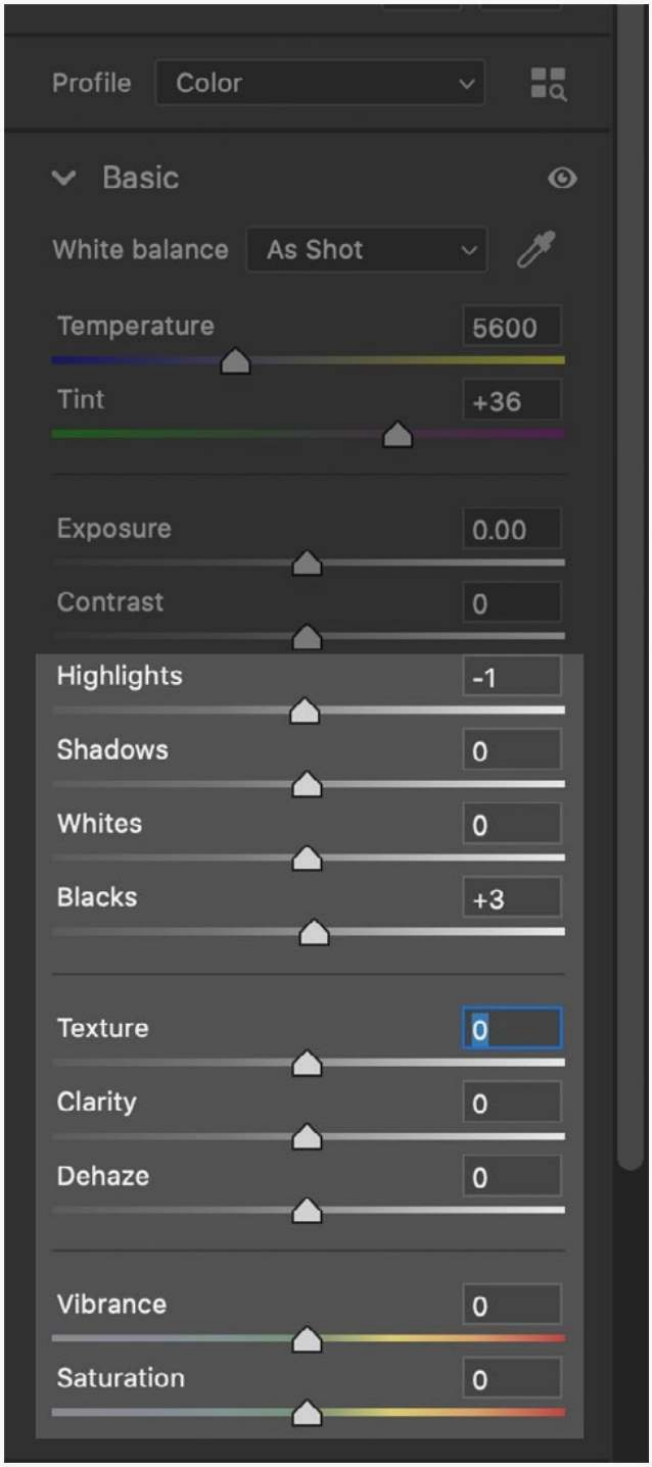
Vibrance

Vibrance is like saturation, but protects skin tones and already saturated colors from getting too saturated.

Saturation

Saturation is how intense the colors appear. With no saturation you have a black and white image, and with a lot of saturation the colors
'pop' unnaturally. This is a common control, and since contrast also effects saturation, it is often needed when you make a contrast change.

Saturation, exposure, and contrast work linearly on the image, while the other adjustments use a bit more 'intelligence', which can lead to a very artificial look when used without discretion.



HISTOGRAM

You may notice that histograms on cameras are dealt with in Chapter 6 of this text. The histograms in Camera Raw are basically the same, but they are more immediately useful when editing images. That is why they are introduced here first.

Get used to looking at histograms as you adjust images. They help you see what is happening to the tones of an image, and so are very important. As you get better at the controls they will become even more helpful... but only if you know how to use them.

TONAL ADJUSTMENTS

Most students tend to drag the more advanced controls discussed here wily-nilly in strange ways that fight each other. Be intentional!

In other words, do the basic exposure and contrast adjustments first, then invoke the others only as you need to. So, if you adjust the exposure and contrast, then find you need the shadows to be lighter, only then use the shadows slider (see example of this below). Adjust the same way for the other controls.

This is a good time for you to review how to compare images side by side (1cr) so you can see exactly what is happening when you make an adjustment. Just make one adjustment at a time (then reset it) to see what each slider does.

All of this takes practice. I wish I could tell you how to use any control in Camera Raw and suddenly you would know how and when to use it, but it doesn't work that way. Practice is the only way to learn these controls. This book only gets you started.

CAN YOU...

Understand the basics of what a histogram is showing about your image?

Predict the contrast and exposure needs of an image just from the histogram?

Turn on and off the clipping buttons to see the tones outside areas of an image?

Understand the function of all the sliders in the basic tab of Camera Raw?

Identify and change the sliders by dragging directly on the histogram?



Camera Raw comparison view showing difference of only shadows adjustment

3.2: 3CR HISTOGRAM is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

4: Sensor

Deep in the bowels of your camera, behind the lens and shutter (also behind the mirror on DSLRs), lies the sensor. This is the delicate (and expensive) silicon chip that the image is projected upon. Like your eye's retina, this chip is responsible for recording an optical image and converting it to something the brain can recognize. In the camera's case, the brain is a little computer inside the camera. This chapter examines how a sensor works along with some practical implications of this.



The sensor here is green. It is normally covered by both the shutter and the mirror on a DSLR.

The surface of a sensor is made up of millions of microscopic squares in a grid. These squares are called pixels. Each one of these pixels is capable of reading the brightness of light that falls upon it from the lens and converting this brightness to a number between 0 and 255. These numbers are called levels. If no light hits the tiny pixel it will output the level 0. If a lot of light hits the pixel it will output the level 255. Your camera's 'brain' interprets 0 as black and 255 as white and every level in between as varying lightnesses. Each of these millions of pixels output different levels according to the brightness of the light hitting it. This is how an image is constructed by the camera's computer.

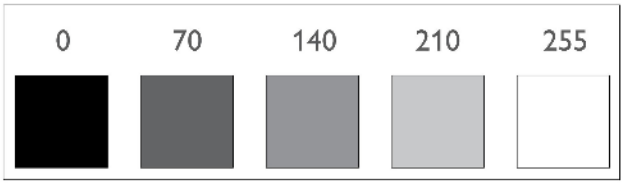
A newer camera may have a grid of 6000 by 4000 pixels. If you remember your math, 6,000 x 4,000 is 24 million. That is a lot of those microscopic pixels, each reporting to your camera's computer the amount of light that hit it.



The effective sensor for this image has a grid of 100 by 50 pixels. Since each pixel can be only one color or tone at once, having 5,000 pixels is not enough.
Fewer pixels means each pixel has to be bigger. That is why the pixels here are big enough to clearly see.



On the left is an enlarged pixel on the sensor. On the right it is shown actual size. Each pixel on the sensor is too small to be seen with the naked eye.



The pixel on the left was hit by no light, so has a level of 0 and will be black in the image. The pixel next to it was hit by a small amount of light so has a level of 70 and will be dark gray in the image. So on for the others.
Sometimes these numbers are expressed as a range from 1–256.

Film and Sensor

The main operating parts of a camera have remained unchanged for over fifty years. The only significant change has been to replace the film, a light sensitive piece of plastic, with a sensor. So, with a film camera, you would load a strip of film and take a picture. This would make an image on a small portion of it. You would then wind to a new piece of film.

Having a high number of these pixels is crucial. Imagine a sensor that only had four (below). Every photograph you took would only have four differently toned areas. It would be a stretch to call this image a photograph. So, the more pixels there are, the better. This is why camera manufacturers tout the number of pixels as a megapixel number, with 24 million pixels reported as 24 megapixel.



4 pixel image of a calico cat chasing a mouse

Pixel is short for picture element, and since each can only be one color, pixels are indeed the basic elements that make up an image, whether it is in a camera, on a computer screen, or contained as information in an image file.

Color

Humans are only sensitive to three different colors (wavelengths, but let's not get too complicated) of light. These colors are (very) approximately red, green, and blue.

Wait (I can hear you say), I see more than three colors! Not really—when you perceive a color such as yellow, what you are really seeing is a mix of red and green. By mixing red, green, and blue in varying amounts of intensity (brightnesses) you perceive many different colors.

A camera's sensor works in much the same way as our eyes. Each microscopic pixel has a color filter covering it. This filter is either Red, Green, or Blue (RGB), making that pixel sensitive to only that color. If it has a blue filter covering it, only blue light is let in to activate the pixel. The same for red and green. This is how the sensor interprets a full range of color.

Pixels Don't Exist

The term pixel is actually a lot more slippery than you might think, and some would claim that in reference to a sensor, there is really no such thing because pixels are descriptions, not objects. But, like defining light as light rays, defining a whole range of similar things as pixels has practical benefits and isn't terribly incorrect.

Rods & Cones

The bright-light sensors in your eyes are cones, and they are each sensitive to one of three wavelengths (colors) of light, which is how you see color. The rods are for dim light, and there is only one kind, so in very dim situations you do not see color.
Some people have four or more types of cones, but it is unknown what functionality the extra ones have. ...Remember that I have pointed out that you didn't have to read these gray sidebars.

Since every pixel in the camera sees only one of three colors, the number of pixels that accurately depict color is only a third of the total number of pixels. The camera's processor guesses at (interpolates) what color each pixel should be based on its neighbors' color and tone.

Most color is made or viewed using three colors, and it is a process that has been in use for well over a hundred years.

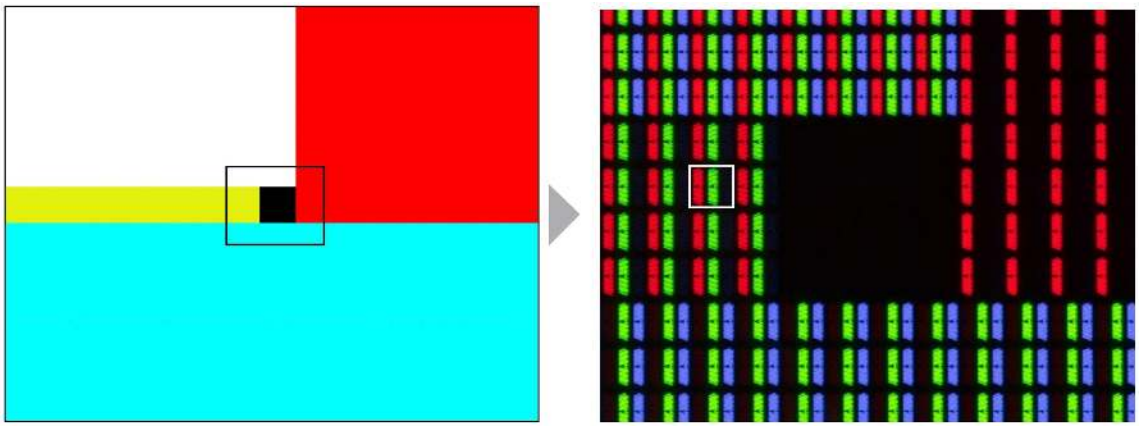
For example, three colors make all colors that can be seen on the display with which you are viewing this book. The screen is actually made up of very small areas of only red, green, and blue. Unlike the sensor, each set of the three RGB colors makes up one 'pixel' on the screen.

So, while a pixel in a camera image is one color made from components of RGB, the screen has the set of three RGB colors contained in each 'pixel'.

Pixels and Bits

Since those tiny pixels in the camera image are the basic building-blocks of an image, they deserve a closer look in relation to to color. Remember that unlike the screen, each pixel in a photographic image is simply a square of a single color.

In a black and white (grayscale) image, each of the pixels can be any one of 256 levels, or shades of gray. This 256 level image is called an 8 bit image.



LEFT Color image in Photoshop unmagnified. Black rectangle shows detail magnified at... RIGHT A detail of this same image showing a very high magnification of the screen. A yellow ‘pixel’ is shown with the white square.
The red, green, and blue portions
of each ‘pixel’ get lighter or darker according to the color of the object. Our eyes mix the colors at normal viewing distance.
The image on the right is an actual photograph of part of the left image displayed on a screen. A macro lens which allows for a high degree of magnification was used to photograph the screen.

More Pixels and Bits

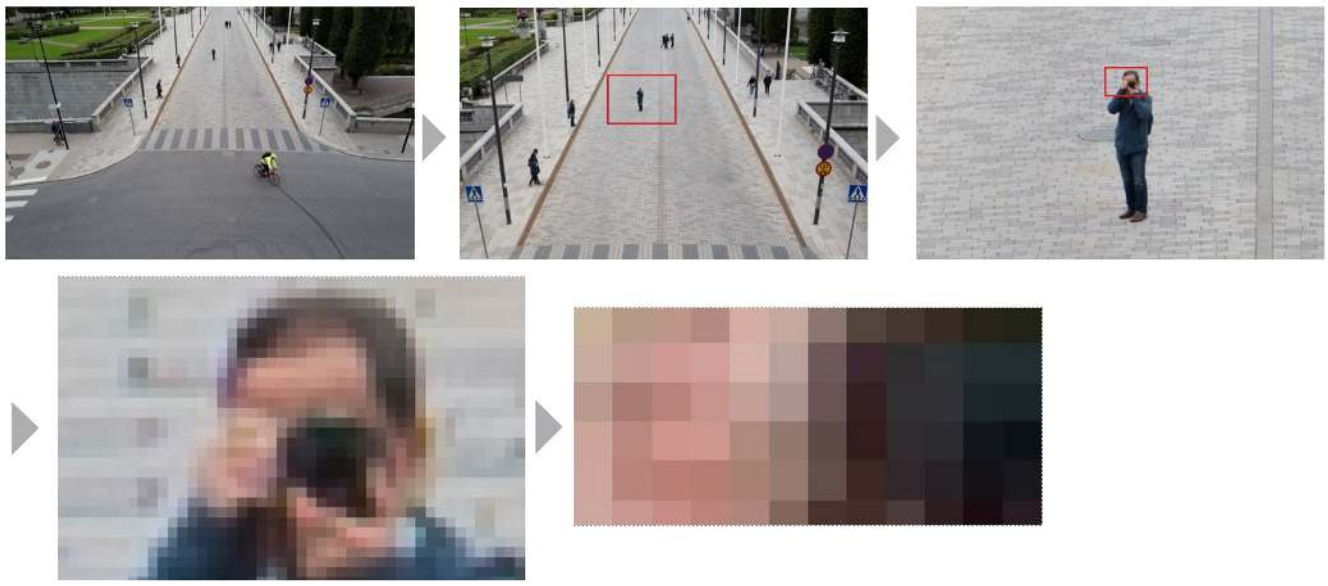
8 bit means that there are 8 binary options for each pixel. These binary options are the computer’s most basic way of storing information. So, 2x2x2x2x2x2x2x2=256. This range of tonal (or color) possibilities is also called the bit depth of an image.
24 bit images have one of these channels for each of the three (R-G-B) colors, so 8 bit+8 bit+8 bit=24 bit.

Color images have one of these 8 bit channels for each of the three colors (Red, Green, and Blue). These are called 24 bit RGB images. Each pixel in 24 bit images can be one of about 17 million colors.

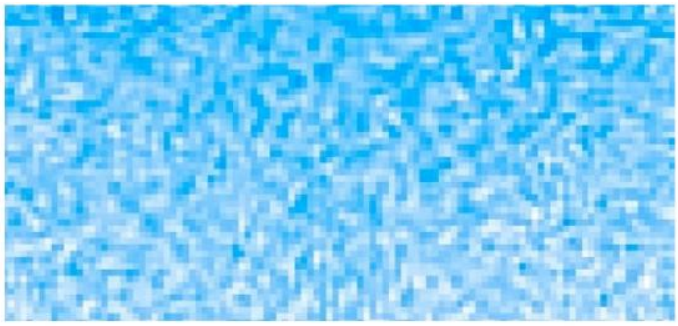
You might see some images that are described as having more than 24 bits (8 bits per channel). Each pixel is still a single color, but there is added information such as tones that exceed 256 levels or an overlay of transparency information.

Pixel Flaws

Previously it was stated that the more pixels a sensor has, the better. This is not strictly correct because in the real world, every pixel is far from perfect. We have already seen that each pixel can only decode one of the three colors by itself, so must interpolate some color information.



Enlarge any digital image and the individual pixels are easily seen. Each pixel is only one color. Since the pixels are usually too small for our vision to distinguish, they merge to form a coherent image.



Close crop (detail) of clear blue sky. Contrast is increased to clearly show pixel variations.

When working together, individual pixels in camera sensors have many flaws. One of these flaws can be readily seen: In Photoshop or some other image program, look at a photograph with a large color area like the sky. Now enlarge it enough to see the individual pixels. You will notice that what should be all the same color and tone of pixels is populated with many different colors and tones. The better the sensor, the less variation in tone and color you will see, but even with a sensor in an expensive camera you will see quite a bit of variation.

This sensor defect is called noise, and in some situations it can very noticeable, such as with small-sensor cameras and photographs taken in low-light situations. There are a many other sensors defects (including in the route from the sensor to the processor), but it is enough to know that all pixels have faults, and as a general rule, inexpensive cameras have inferior pixels and more faults in sharpness, noise, color, and tonality.

Sensor Size

A general rule of thumb is that larger sensors (in physical size) have better pixel quality and therefore better image quality. This is regardless of the number of megapixels. Unfortunately, a larger sensor also means a larger, heavier, and more expensive camera.

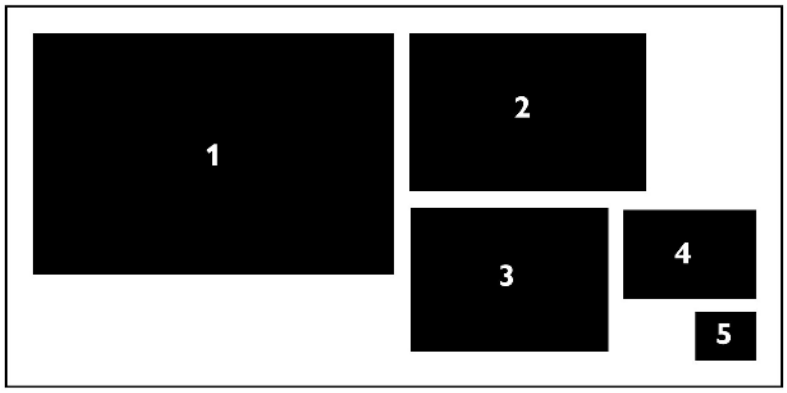
The largest common sensor size is called a full-frame sensor because it takes it's size from the 35 mm film used in film cameras. The width of this sensor is 36 mm (1.4 inches). This size of sensor is capable of very high quality, but the sensor itself can cost well over a thousand dollars, and cameras that use this size are large.

The next size smaller in common sensor sizes is called an APS-C, which also takes its size from a film camera format. This sensor's width is 23 mm (0.9 inches). It is the sensor size used in most cameras discussed at the beginning of this book, and in many ways it is the sweet spot in sensor size. Although it has less than half of the area of a full-frame sensor, it is still big enough to make very high quality images. It is a fraction of the cost of the bigger sensor, and allows the camera to be much smaller and less expensive. Only slightly smaller is the Four Thirds System sensor which is also a very common size.

Sensor sizes smaller than the one inch sensors found in smaller mirrorless cameras come with much lower potential image quality. With improvements in cellphone camera sensors (which are necessarily extremely small), it would even be safe to say that small point & shoot cameras are rarely worth buying unless you want the telephoto feature they have. These small cameras have few usable controls and their image quality is only slightly better than cellphones.



Image detail of people in low light. Without noise (with perfect pixels) the shirt would be one color and tone. I am not sure if the woman would be winking or not...



Relative sizes of 1 a full frame sensor, 2 the APS-C sensor found in most DSLRS, 3 the Four-Thirds sensor in many mirrorless cameras, 4 the one inch sensor in some better point and shoot cameras, and 5 the sensor in a cellphone camera.
Interestingly, one inch sensors are not really one inch in any dimension.

White Balance

Different light sources emit different colors. For instance, the light from the sun is yellowish-orange compared to the light from the sky, and the light from the sky gets much more blue after the sun goes down. Indoor lighting is much more yellowish than daylight, unless it is fluorescent light, which is also greenish.

Your eyes (actually brain) pretty much always adapt to the color of these light sources, so you don’t even notice that they are different colors. But you can see them by fooling your brain a bit: After the sun goes down, but while it is still light out, turn on

your inside lights, then walk out of your dwelling and look back into the windows. See how yellowish it looks in there? Walk back in and the yellow will disappear.



The same scene at different white balances.
At left the white balance is set to daylight, the approximate color of the light hitting the outside of the house (notice the yellowish light inside the house).



This image is set to incandescent, the approximate color of the interior lighting of the house. In the evening (as in this example) you can see the different colors of light with the naked eye if you are aware of it.

The camera, like our eyes, adjusts to different colors of light if you leave it set to Automatic White Balance. But our eyes do a much better job than the camera. Take a photograph of green grass and your camera might think you are taking a photograph in an office building and take out a large portion of the green. Or take a picture indoors and your camera might think you are just taking a picture of a bunch of yellowish things, so it won't take the yellow out.

If you are saving images as JPEG, this color cast cannot be removed effectively during editing.

You have two choices to solve this white balance problem. The first is to tell the camera directly what type of light is illuminating the scene. You will find white balance settings for many lighting situations on your camera, but there are three main categories.

DAYLIGHT is the color balance for things lit by the sun. There are pickier settings on your camera, but any one of the daylight (sunlight, shade, cloudy) will get you into a range where you can make final adjustments in an image editing program.

INCANDESCENT (sometimes called tungsten) is the color of indoor lights that get very hot to the touch. This is also the color of many of the newer LED lights that are labeled as warm white.

The different colors of the light (from daylight colors to incandescent light) can be described as a color temperature, which is designated by Kelvin. 5200K (Kelvin) is the approximate color of mid-day day-light, and 2800K is the approximate color of that light bulb that gets hot or the LED. This is important because you will see these K (Kelvin) numbers going by both on your camera and in image processing applications (where it will be in the form of a slider labeled temperature).



The cellphone camera is seeing a lot of orange, so it thinks the image is being illuminated with orangish light, and it removes what it thinks is this color cast. This works the same with all cameras when set on automatic white balance.



Typical white balance setting in a camera menu. Note the 5200K (Kelvin) description.

FLUORESCENT is the description for lights that are fairly cool to the touch and are shaped as tubes or as coiled tubes. The color of these lights cannot be described only by Kelvin, and the additional setting and correction for this color is labeled as tint in image

editing applications.

Setting the color for the light source in your camera is the first solution to this problem of the color of lights. The second solution is a lot easier and better in most circumstances. It is to use RAW format.

RAW Format

In the first chapter RAW format was briefly explained and you were directed to save your files in this format. Following is a more complete explanation of why RAW is better than JPEG.

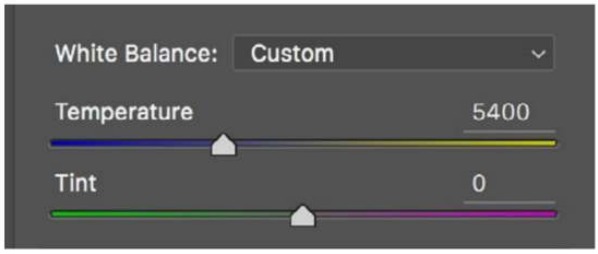
Remember that the sensor outputs numbers according to the amount of light hitting the pixels. RAW format saves those levels from the sensor fairly directly, without much input from the camera's computer—instead, it uses the computer you download them onto to process the images. There are significant advantages to this way of processing images:

WHITE BALANCE: With a RAW image, the white balance is not applied to the image in the camera as it is with JPEG. Instead the white balance your camera is set to is only used as a reference, and it can be changed in editing.

So in the previous examples of white balance, the photograph of the smoky house is balanced two different ways from the RAW file. If instead it was saved as a JPEG and the color temperature was set to 2800K (either by auto white balance or setting it for tungsten), the best color that could be had would look something like the top image to the right. No amount of adjustments can correct the color.

If this was the only advantage of RAW format it would be a terrific way to save images. But there are more advantages...

EXPOSURE CORRECTION: At the beginning of this chapter it was noted that an image is made up of 256 tones or levels. With RAW images, more levels are actually saved. So, a color RAW image is more than 24 bit. How much more depends on the camera. What this means is that if your exposure is a little off, it can be easily corrected, as the sensor is actually saving tones above white (255) and below black (0). Getting the correct exposure is still important, but not nearly as important as with a JPEG format image.



White balance in Adobe Camera Raw.





JPEG file (top) and RAW file adjusted to the evening light. Notice that the top image is both reddish and greenish at the same time. Since these colors are opposites (color crossover) they cannot be balanced out.

More levels being saved also means that an image can have more adjustments applied during image editing. In a Raw processing program such as Adobe Photoshop Camera Raw, contrast can be increased, colors changed, and tonality fine tuned. The quality of the image will not be diminished as with a JPEG.

OTHER SETTINGS: Many other parameters of the image are also set in the camera with JPEG format, such as sharpness and type of color rendition. With RAW files these parameters can instead be set or changed any time after the image is taken.

PERMANENCE: You cannot change the tonal information in a RAW format file. Although this might not seem like an advantage, it is. When you make a change to a RAW file, it doesn't change the image information in the file, but instead lists instructions on how the changes should be made. These changes are applied whenever you view the image.

For example, if you open a RAW image, then make it too bright, it will not actually change the image part of the file, but instead includes instructions to make this image too bright. This means that you can always go back to every bit of information contained in the original image.

These instructions for the RAW changes may be saved in several places, including in a portion of the file reserved for instructions or in the image editing application itself. Often they are saved in a separate file, called a sidecar file. This file should always be moved whenever you move your image file.

These are the reasons people interested in taking good photographs almost always save their images as RAW format.

Any RAW format file can also be converted to a Digital Negative (.DNG). This is a format Adobe developed as a standard RAW format. The Digital Negative format has a good chance to become a standard across the industry. Already some manufacturers are using it as their cameras' RAW file format.



Two views of RAW image files and their sidecar files (.xmp) in the Macintosh finder.
Sidecar files are automatically created when you first make edits to an image.

Color Temperature?

It was found that the color of light could be quantified by heating a metal. As the metal got hotter, it would first be yellowish, then gradually change to blue. The temperature of the metal was then used as the reference point for the color it emitted. The temperature scale used was devised by Lord Kelvin. Hence, the color temperature (e.g. 5000 Kelvin, or 5000K for short).

Light Source

Any light falling on your subject is actually a combination of many different wave-lengths (colors). Not all lights are created equal, however, and some light sources are deficient in some colors. If you can find a orangish streetlight, stand under it in a colorful outfit. You will find that your outfit will be totally without color. Your clothes just can't reflect a color that is not there to begin with.

Generally, lights with bad color are found in big-box stores, arenas, and other large areas that need inexpensive lighting. Try to avoid photographing with these.

ISO

How sensitive the sensor is to light is governed by the number you set for the ISO Speed (often called just ISO so as not to be confused with shutter speed). So, to take photographs in low light situations you can set the ISO to a higher number to allow you to take photographs at a shutter speed that will prevent blur.

Most things in photography come at a cost, however, and being able to make the sensor more sensitive to light also degrades the image. The most noticeable effect is an increase in noise—that random dot pattern covering the entire image that was discussed earlier. At higher ISO settings there is also an unpleasant shift in colors and sometimes horizontal bands across the image.



The light illuminating these fetching bovines doesn't have a full spectrum of colors so accurate color cannot be had, even with RAW format.

Disappearing files

Image files from my first digital camera cannot be opened in any application made today, nor can any application with which they can be viewed run on a modern computer. Like videotape, not only has the medium become obsolete, but any creation done with that medium is gone. The same will happen with today's file formats.

Different computer file formats come and then they go. Like JPEG, the Digital Negative file format is in use by many people, which fortunately means that it has less of a chance of going away. So in twenty or thirty years you will have a better chance of opening that file. It is nice to know that Digital Negative exists, although you probably don't need to convert your files to that format yet.

Newer and larger-sensor cameras perform better at higher ISO settings, but following are some general observations that apply to most cameras. Your camera will also have intermediary ISO settings.

ISO 100: This is the lowest ISO on most cameras. It needs the most amount of light and has the highest quality.

ISO 200: This number makes the sensor twice as sensitive to light as ISO 100. In most cameras, this is almost indistinguishable in quality from ISO 100.

In photography, twice or half the amount of light is referred to as a stop. This will get more important later in this book, but you should remember that definition now.

ISO 400: This is a good all-around setting for most cameras. There is some increase in noise, but you get 2 stops more sensitivity to light as you do with ISO 100 (4 times the sensitivity).

ISO 800–1600: 3–4 stops more sensitive to light than ISO 100. Are you getting the way ISO numbers double with each stop of sensitivity? You can really see the noise at these speeds. In other words, a strong curse or two is in order when I forget to reset my ISO from 1600 if I am taking photographs where I need quality but don't need the sensitivity.

ISO 3200–[your camera's maximum]: These very high ISO speeds show glaring faults, with not only plenty of noise, but also banding and color shifts. But if that is the only way to get the photograph, then go for it. Life is not always ideal.

ISO and Noise

Noise is an interesting concept. The word comes from the Latin nausea, meaning sea-sickness. In English nausea is something that is also unwanted (although you might want an excuse to get off a boat).

Noise is perhaps familiar to you from audio. Even with digital audio (without volume cut-outs), turn up the volume for quiet sounds and often you will start to hear artifacts of the electrical system. A hiss or static.

This is exactly what noise is in camera images. Light that is very quiet (low) starts to become indistinguishable from the electronics reproducing it.

The word noise can be used in many other circumstances, such as needless information that obscures pertinent facts. Like the fact that it is hard to see climate change because of all the normal variations in weather. In the same way, noise in images obscures the subject of the image.



Close crop of two images. The left image is ISO 1600. The right image is ISO 12,500. High ISOs produce more noise in an image.

Changing the ISO setting while shooting is straightforward. If you can't hold the camera still enough or the subject is moving fast enough to cause blur, you probably want to set your ISO higher (to a higher number). Otherwise, just leave it at 400 (perhaps 100 if you are out on a sunny day).

If you need to see the amount of noise or blur using the camera review, enlarge the review image (see your camera instructions) since the small image will not readily show details such as these.

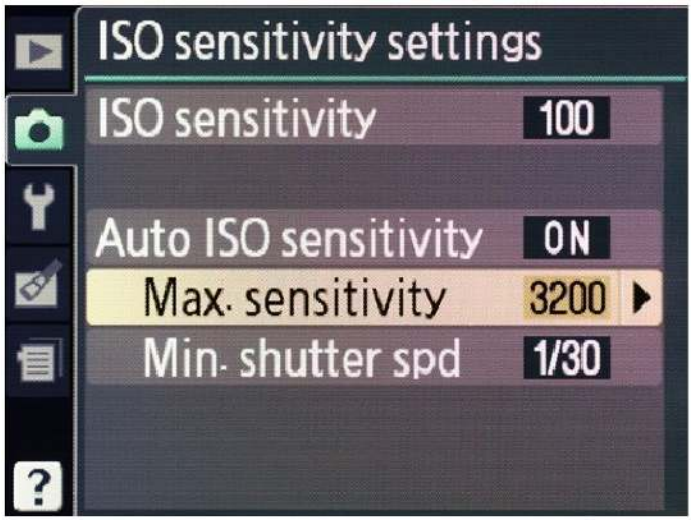
Automatic ISO

When camera designers set up the parameters for automatic ISO, they err on the side of getting a photograph without motion blur. What this means is that ISO goes up very soon in auto ISO mode, making for very noisy images. Not good. I have had plenty of students who complain of very noisy images on automatic ISO—this is one reason why I had you disable auto ISO at the beginning of this book.

That being said, there may be times when you want to use auto ISO and let the camera pick the speed for you. Perhaps you are in a situation where the light varies widely from one second to the next, when you just don't want to think about it, or when you loan a camera to your grandmother.

Some cameras (especially newer ones) have automatic ISO settings that let you specify how it works. These settings make automatic ISO much more controllable and practical.

You can set the highest ISO the camera will choose so that you can avoid those ISO speeds which look like shite to you. You can also pick the slowest shutter speed (sometimes called the minimum shutter speed and sometimes called the maximum exposure time!) so that the ISO will not increase unnecessarily.



This camera menu allows you to specify how automatic ISO is used.

ISO

...stands for International Organization for Standardization. This organization sets standards for all sorts of things. I wish that explanation could have been more interesting.
But why not IOS instead? Try to imagine coming up with a name (ISO) that sort of translates into many languages. You can't make it for only one language because... well, think about it.

Now Go Shoot

Like the last chapter, a hefty portion of this one has background information that serves to increase your understanding of the photographic process. What is hap-pening behind the curtain is important whenever you are trying to get better in any pursuit.

But the chapter also contains some things you can use right away. The color of different types of light and what to expect from this. The importance of using RAW format. Changing your ISO to make the trade-off between image quality and preventing blur.

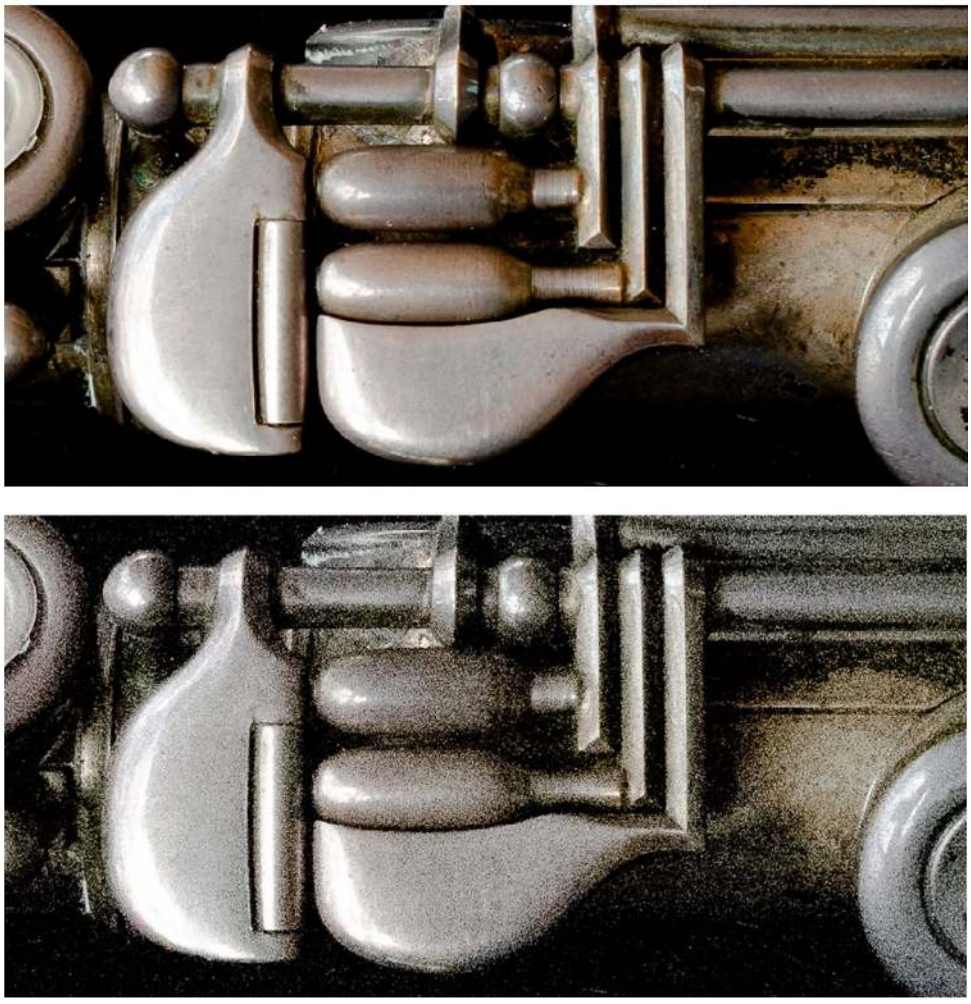
Keep these things in mind as you shoot photographs. Some day there may be cameras that do all of this thinking for you—that can read your mind about how to interpret a subject or the colors of that subject. But I doubt it.

EXPERIMENT

Take four or more photographs of exactly the same thing, but change the ISO setting on your camera.

You might want to have plenty of light for this, as lower ISOs will automatically set your shutter speed slower. This might cause a blurry image which will prevent a valid comparison. You could instead use a tripod or some other camera support to ensure sharpness.

Rename your files something like ISO 100, ISO 200, ISO 1600. You don’t have to remember which is which since all image editing programs will report the ISO used along with other metadata.



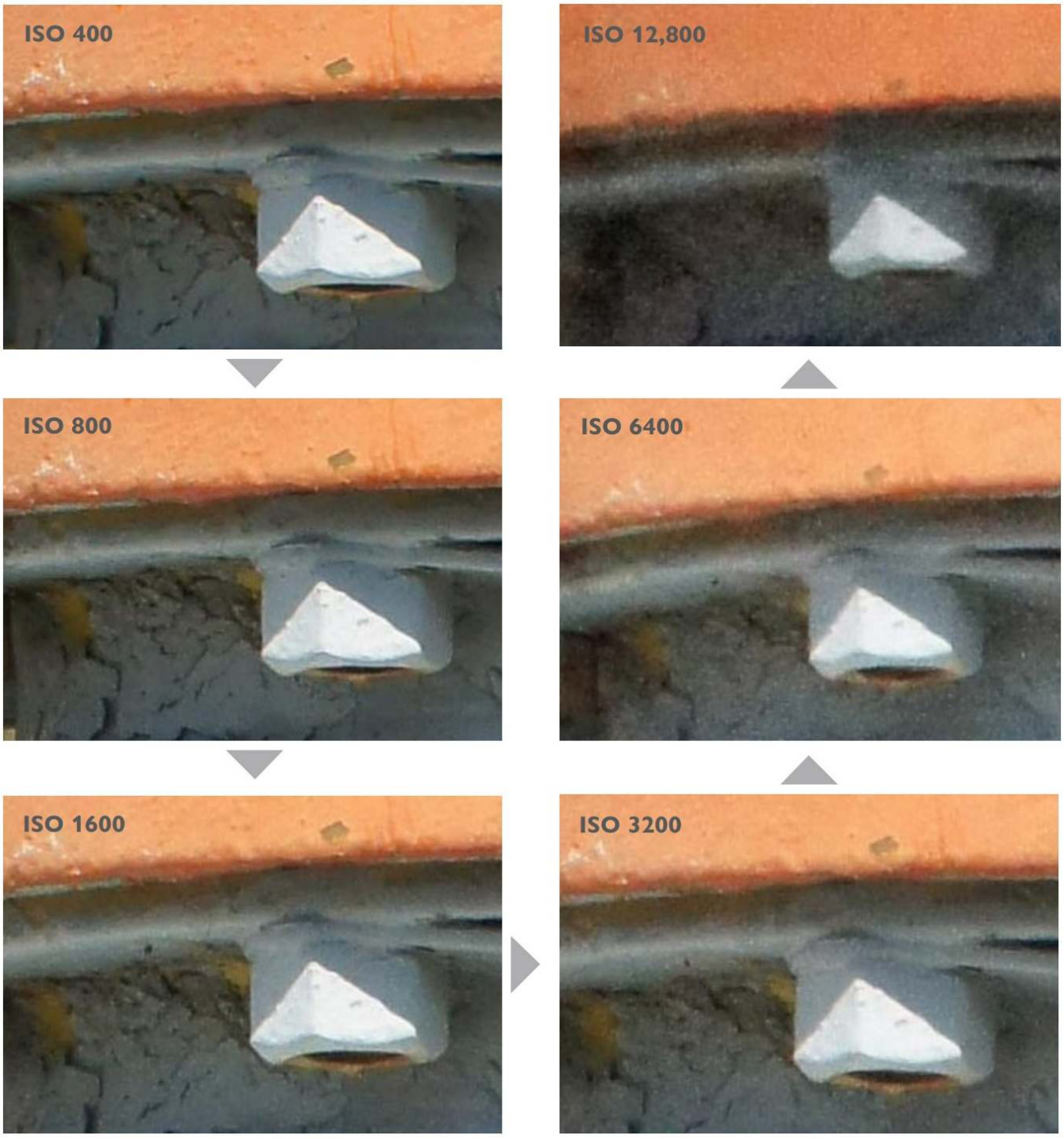
Comparison of two ISO settings (detail)

In an image editing program compare these at 100 percent (1:1) magnification and note the differences. Which is the highest ISO that has the most quality? How bad is the quality of the highest ISO?

Now view the image in the fit to window magnification. How is the quality at this magnification? Could the images be used small on a web site or email? Different cameras will present different answers to these questions.



Ali Brown, ISO experiments. Entire image above, details at right. ISOs below 400 were omitted since in these illustrations the differences were minimal.



Sensor Questions

What device in your camera converts light levels to numbers?How many pixels are in a modern sensor (very approximately)?What three colors is the sensor sensitive to?

How many colors can one image pixel be at once?

How many shades of gray are possible in an 8 bit image?How many ‘bits’ are there in an RGB (color) image?

What is one shortcoming (defect) of pixels on a sensor?What is an advantage of a smaller sensor? A disadvantage?How did the full-frame sensor size originate?

Why can you usually not see the different colors of light? Why might your camera get the color of a scene wrong? What type of light is hot to the touch? What type is cool?

What measuring system defines the color temperature of light?

What is an advantage to shooting in RAW relative to white balance?

What is an advantage to shooting in RAW relative to exposure?In what type of file are changes to RAW images often stored?What is the Adobe standard format for RAW files?

Why are some light sources bad?

What defects do high ISOs introduce?

What ISO gives the best quality?

What term describes twice or half the amount of light?Which ISO best for very low light?



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4.1: 4PH SOCIAL PHOTOGRAPHY

Selfie sticks are a bit sad. Before they were invented, people took photographs of where they were, not themselves in those places. And if they wanted a photograph of themself at a place, they were required to hand their camera to a stranger and trust they would be in the frame and their camera would be handed back undropped. That was the price of admission in the good ol' days.

I would much rather see a photograph of where you were in solitude. Annotated with a description of how you felt when you saw that beautiful lake (or whatever), with excuses that the photograph really doesn't do it justice. As a viewer I don't want a camera grin and a badly composed shot that cheapens the whole experience. That metal pole is a poor replacement for the person you wish was there with you.

Photography is a social pursuit. Not only in the interaction of photographer and subject, but in other ways as well. After all, we take photographs to communicate with others, even if that other is your future self.

A few years back I was with my wife at Artist's Palette in Death Valley. The sun was low, and I was taking photographs of our shadows below the cliff. Another couple saw us do this, and so they did the same thing. After a while we stopped, but other tourists joined in, and as people came and went it spread like a meme to each new set of people visiting. This is what I mean by a social pursuit. It is an acknowledgment of bonds that humans have with each other. We experience the same ways, we are all in this together. In the end we are all the same tribe.





I have hundreds of photographs of my wife in front of this or that. And in turn, these are very much like millions of photographs taken every day of friends and family in front of this or that. In other words, these photographs are quite the opposite of unique. And that is the point—I am taking part in a ritual that has gone on since photography was first invented. In many ways we all see the same thing.



The photograph reproduced on this page is of a person taking a photograph during the same trip to Death Valley. I take a lot of these photographs of people in the landscape, and in a way, they are all self portraits, even though I have not met the people. That small person, just visible, is also close and transparent. They are feeling the same things I felt when I was there. The immensity of the landscape. The hot day breaking way to a cool breeze over the salt flat. A day of exploring almost done, but you don't want it to end.

Unless you are an ass, whenever you take a photograph of another person you are entering a social contract. Even with that little person who has no idea they are being photographed. I have taken photographs that were 'unfair' to the people depicted. I usually delete these—it is part of the contract.

The contract is very clear when you take a portrait of someone. The person photographed is giving something of themself and trusting the photographer to be respectful of how they want to be interpreted. That photo smile people assume when the camera is pointed in their direction is more than a convention. It is a defense just in case the photographer doesn't understand the contract.

Of course the contracts I am talking about here are unsaid. They point to deep understandings of the responsibilities we have to each other. Sometimes photographs don't seem to conform to these social contracts. For example, in times of extreme strife, subjects will let photographers portray them in the deepest of despair. The normal social contracts have been broken, and new ones take their place. These subjects need the world to see the injustice*. The iconic example of this is the child running naked after a napalm attack. It is a horrific image that conforms to social norms simply because of the horror. The section of this book on photojournalism presents photographers who deal with their subjects in this way.

Photographers also deal with upheavals in a cultures. **E.S. Curtis** was mindful of the fact that the traditional Native American culture was being decimated as he photographed those cultures. **August Sander** worked to depict every occupation of the German people. A testament to the humanity in his pursuit was the fact that the Nazis destroyed the resulting book. Not a lot is known about **E.J. Bellocq**, whose photographs of early 20th Century prostitutes describe a subculture rarely seen in history. **Andrew Strout** depicts an India which is quickly disappearing, **Judy Dater** approaches women's issues in a personal manner, and **Nicholas Nixon's** portraits done in a nursing home are powerful examples of the tenderness with which he approaches all of his subjects.

Photographing celebrities brings in a different kind of social contract, especially since many are actors either looking to increase their fame or take a break from it. **Anne Leibovitz's** photographs show a different side of famous people while still being marketable. **Richard Avendon's** gritty portraits of the famous are in themselves famous, while **Arnold Newman** uses abstraction and symbolism to define the personality of his celebrities. **Larry Sultan's** images show a detached view of celebrities (and others). **Yusuf Karsh**, **Ruth Orkin**, and **Philippe Halsman** take more conventional approaches to describe magnified personalities.

*This is from a quote by the photographer James Nachtwey. His biographical film War Photographer is an excellent movie about photography, journalism, and dedication.

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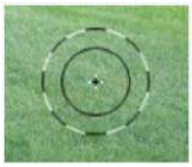
4.2: 4CR LOCAL ADJUSTMENT

The Camera Raw adjustments covered so far work across the entire image. For example, when one area is made lighter, all areas of the same tonality will become lighter.

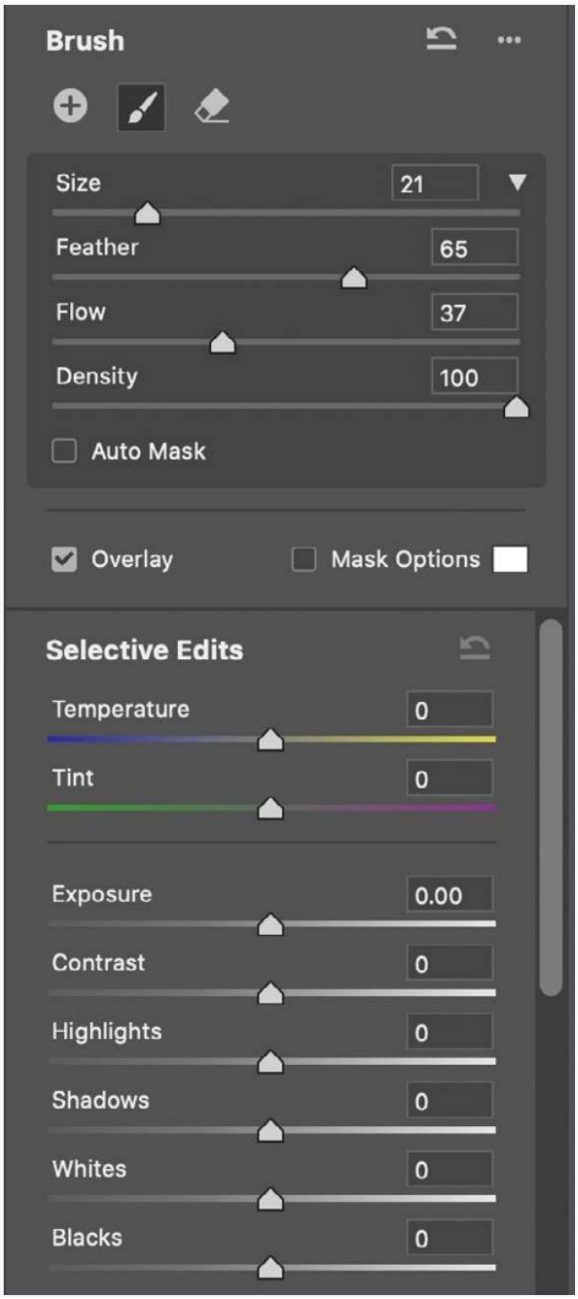


But what if you want to adjust only part of an image without influencing other parts? This is what local adjustments do. To start making these, click on the adjustment brush icon on the right of the Camera Raw workspace.

Two things happen when you click this brush. First, the panels on the right are replaced with the Adjustment Brush panel. Second, the cursor turns into a double circle when over your image. The outer circle shows the brush size that you will be using when you paint in your adjustments. The inner circle shows what will be fully painted. The adjustment will fade out (feather) to the outer circle. Outside of that circle there will be no effect. Without this fading you would see hard lines bordering the adjustment.



On the upper panel, Size is the outer circle, and Feather is the inner circle compared to the outer circle. Flow is the amount each brush stroke will paint in (you can paint multiple strokes over each other). Density is the total effect of multiple brush strokes (this can be left at 100 since you can decrease the adjustment just as easily). Make sure Color (scroll down in the panel to see this) is set to none. Otherwise your adjustment will take on a color cast you probably don’t want (I don’t know how students keep stumbling upon this!).



Most of the important adjustments available with the adjustment brush should be familiar to you by now.

You can make adjustments either before or after painting the area for them, but you should probably set the approximate adjustments you are considering before you start painting—this way you can see the results as you paint.

Important: Using the adjustment brush in this way you are not changing the tonality of objects. Instead, you are changing the tonality of areas.

You can make as many adjustment brushes as you need by clicking the plus button at the top of the Adjustment Brush panel. Clicking the eraser button allows you to erase parts of the adjustment painting you have done.



Each session of painting is marked by a small circle (an overlay) where you started painting. This is red when active, and white when inactive. You can make a session active by clicking on the circle, and you can delete an active session by hitting the delete key when it is active.

When you go back to a session of painting, the adjustment brush options will zero out. If you are using the same adjustments multiple times you can turn off this reset at the very bottom of the panel (scroll down).

Notice that you can change the color (hue) of your adjustment by either using the temperature/tint sliders or by using the Hue

slider. Don’t use Color as pointed out before.



Trevor Finchcamp, before local adjustments



Trevor Finchcamp, after local adjustments to darken the top area of the image and lighten and increase contrast on bottom



Original image



Background area was lightened and foreground area darkened. The sculpture on the left was lightened more by using auto mask (next page).

A Mask in Camera Raw is a selected area. When you are painting in adjustments, you can view the mask by clicking the Mask button below the adjustment brush panel. This color of the mask can be changed by clicking the color rectangle next to the Mask button.



Showing the mask is simply a viewing aid —it will not change the image.

Auto Mask

Much different from the viewing mask above, with Auto Mask turned on (arrow below),
the adjustments brush will attempt to find boundaries in the image and constrain the painting to within those boundaries. What this means is that you can actually use the adjustments brush to not only adjust areas, but also to adjust things in the image.

Often when using auto mask you should first paint within the edges of the thing you want adjusted, then turn off Auto Mask to paint in the rest of the thing to be selected.

Painting and erasing (also using auto mask) at enlarged views is a way to refine the edge, and you may have to repeat this several times to get the right masking edge.

Auto mask does have its limits. Edges in images often include transition pixels that are neither the color of the object nor of the background.

In general, do not expect to make radical adjustments using auto mask to define things.



The image above shows the red mask defining areas painted while using auto mask. While auto mask does a good job in large areas with definite borders (the people), it has a very difficult job selecting smaller areas and areas with less defined edges (grass). Hard edges are actually composed of transition pixels (below right) which can cause problems with extreme adjustments.





LOCAL ADJUSTMENTS

Being able to adjust only parts of an image is a powerful technique, but one that takes a lot of practice. You might as well get started now.

Pick some images that might need an adjustment in areas that is different from the overall adjustments, and see what you can do. Make areas lighter, darker, and maybe increase the contrast. Try changing the color of an area using the white balance tools at the top of the adjustment brush panel.

Perhaps find some images that don't need obvious adjustments. Can you improve the image using them? In general, lighter areas draw the viewer's eye and darker areas recede. Can you use this fact to control the way the viewer sees elements in the image?

Experiment. As always, view your changes side by side with the unchanged version to compare them.

AUTO MASK

Use auto mask to limit your local adjustments to just one thing in the image, such as the sky, or perhaps a person's face which is too dark in relation to the rest of the image.

Get the hang of how accurate auto mask can be by enlarging the adjusted image to 100% to view it. In general the heavier the adjustment the more accurate auto mask needs to be.





CAN YOU...

Effectively change only parts of an image?

Make your local adjustments seem natural?Erase and add to portions of your adjustments?Use appropriate brush sizes and feathers?

Use flow to control the strength of the adjustments within an adjustment area?

Make multiple adjustments and then go back and edit each one individually?

View your adjustment areas using a mask and change the color of that mask?

Use auto mask to limit adjustments to objects (tonal edges)?

Use auto mask to paint edges, then fill in areas to be selected with auto mask off?

Small section of a photograph before and after the sky was darkened with the adjustment brush using auto mask. The transition line along the horizon is very obvious on the adjusted image. Auto mask does have limitations, especially with the heavy adjustment seen here.

Two options to hide this limitation would be to make the adjustment not as extreme or make the photograph (and therefore the imperfections) smaller—as shown at right.



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5: Focal Length

Zoom lenses, like the one that is probably on your camera, allow an important control over how a scene is interpreted. This chapter will familiarize you with how and why to use the zoom on your camera along with some other factors that influence focal length and choice of lens.

Focal Length

Any lens, from a simple lens like a magnifying glass to a complex lens such as on your camera, has a focal length. This is the distance from the center of a lens to the sensor. The center of a lens is where the light rays cross. This is shown in the illustrations at right.

But that is an incomplete definition of focal length. Remember (in the Lens chapter) that as you focus your lens on near or far objects the lens moves back and forth towards and away from the sensor.

To add to the definition a fixed distance of focus is needed. This is infinity—the distance from your camera where everything (nearer and farther) is in focus.

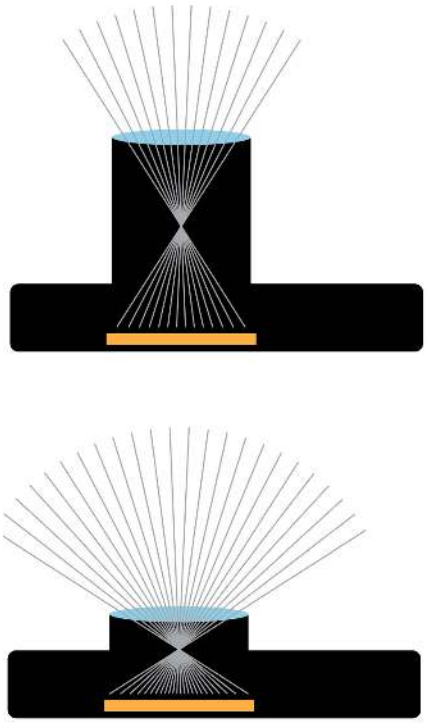
So, a complete definition of focal length is the distance from the center of the lens to the sensor when focused on infinity.

Focal length is important since the focal length of a lens describes how wide or how telephoto a lens will be along with some attributes of those focal lengths.

When the center of the lens is 50 millimeters away from the sensor when focused on infinity, it is called a 50mm lens, and since something needs to be defined as normal, this is a normal or normal focal length lens.

Since it is hard to define normal without context, let's look at abnormal (well, other than normal) lenses.

A telephoto lens is a lens that is longer than approximately 50mm. It is also called a long lens. A 100mm telephoto lens is one that acts more like binoculars. You could say that it brings things closer, but a better definition is that it has a narrower field of view (not to be confused with depth of field).



TOP A telephoto lens has a field of view which is narrow.
BOTTOM A wide angle lens has a field of view which is very wide.

Narrower field of view means the lens shows less area, which makes everything in the viewfinder and image appear to be closer. The physical size of telephoto is also long. This is why photographers taking pictures at sporting events (either football or congressional hearings) have such long lenses. The center of a 500mm telephoto lens has to be 500mm (20 inches) from the sensor.

A wide angle lens is one that is shorter than approximately 50mm. It is also called a short lens, and indeed these lenses are usually physically short. A 25mm wide angle lens includes much more in the frame. Its wider field of view makes everything in the viewfinder or image look farther away.

Zoom Lens

Your camera probably has a variable focal length lens, more commonly called a zoom lens. These lenses almost always incorporate wide-angle, normal, and telephoto—all in one lens, with the focal length adjustable by turning a ring on the lens.

Other than the physical length of the lens, the discussion here about focal length applies to both a zoom lens with different focal lengths built in or separate lenses for different focal lengths.

In addition to field of view, There are two other attributes that are inherent in different focal lengths.

Perspective

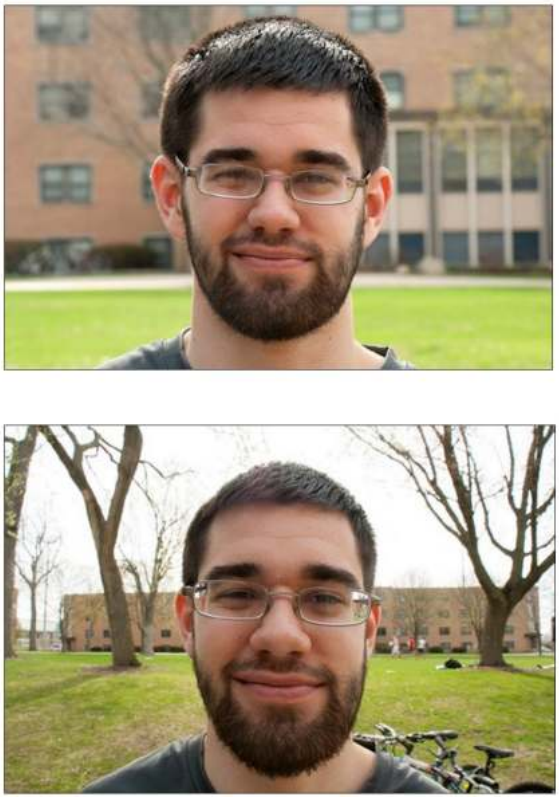
Telephoto lenses (or zoom settings) flatten perspective in an image so that the foreground and background appear to be very close together. This flattening of depth should be familiar to you from looking at photographs of wildlife or sports where telephotos are often used.

On the other hand, wide angle lenses will stretch perspective. If you want to make a friend self conscious about their nose, use a wide angle and get close to them. If you want that cramped seedy hotel room to look spacious and comfy, a wide angle will stretch that hotel room into something that looks palatial.

See the illustrations at right to see the differing perspectives with telephoto and wide angle lenses or zoom settings.

Depth of Field

The amount in focus in a photograph is called depth of field. Less depth of field means less in focus. Telephoto lenses have less depth of field. Things closer and farther away from the camera are generally not in focus at the same time.



TOP Charles Kunene, Telephoto (150mm). Notice the flattened perspective and the out of focus background.
BOTTOM Wide Angle (21mm). Notice the stretched perspective and focus from foreground to background.

Again, the effect of a wide angle lens is opposite. Wide angles have more depth of field, so more is in focus. Again, this can be seen in the illustrations at right and the illustrations on the next page.

Mirror Lenses

There are lens designs that use curved mirrors to make telephoto lenses shorter. These are presently rare.

The degree of all the attributes of focal length (field of view, length, perspective, and depth of field) increase with the numerical increase or decrease. A common telephoto focal length is 105mm, but there are telephotos that are as long as 500mm and beyond. Extenders that fit between the camera body and the lens can also be used to increase the focal length.

A common wide angle lens is 28mm, but there are also lenses as wide as 21mm and wider. An 8mm lens is so wide that you have to make sure your feet are not in the frame when you take a picture.

Zoom Range

Most zoom lenses have a range where the most telephoto setting is about 3 times the most wide angle (e.g. 24mm–75mm).



Telephoto lens (120mm) shows both flattening of perspective and very little depth of field.



Wide angle lens (35mm) shows both stretching of perspective and a lot of depth of field.

A greater zoom range may be handy for you, but note that the greater the zoom range, the worse—or the more expensive, or both—a zoom lens is. Instead, many people get several zoom lenses to cover more focal lengths. Zoom lenses that cover the shorter focal

lengths are called wide angle zooms, while those that cover longer lengths are called telephoto zooms.

Normal Lenses

My feet are normal. As far as I can tell, everyone else's are funny-looking. It is hard to define normal, but in relation to lenses, normal is a lens (or zoom setting) that is neither telephoto nor wide angle, and its attributes are between the other two. A normal lens is around 50mm (about 40–60mm).

Walking

At the beginning of this chapter you may have thought that turning the zoom on your lens was to save you from walking a few steps. That is far from the truth. Although you can use it for that (and for staying a good distance from bears), there is so much difference in perspective and focus (depth of field) in images taken at different focal lengths that you should take advantages of these things more than saving steps.



Since this image has no near and far things (everything is on the same plane), it will look pretty much the same regardless of the focal length of the lens.

Many photographers prefer wide-angle lenses (or zoom setting). The change in perspective is important, and a wide angle gives the viewer more of an impression of immediacy—of being there. It is a more intimate lens. Not many viewers will identify what focal length a lens is, but everyone will surely recognize the feeling of closeness to the subject that photographs taken with wide angle lenses can present.

Additionally, with a wide angle lens you have much more control over how things fit into the frame. A movement of a few inches can make a big difference!

On the other hand, if you like taking photographs of sports or wildlife, a telephoto will be your only choice. Wide angle photographs of football catches or angry dingos might look great, but rarely are they practical to shoot.

Lenses good for head and shoulder portraits are traditionally around 85mm, since this focal length gives a fairly natural flattening (perspective) to the face.

Photographers tend to find a favorite focal length. You can take note of the zoom settings you like to use when you have a choice, and try different settings to see what feels most natural to you.



Wide angle lens showing an intimate view. Notice how just moving the camera a few inches will change the relationship of elements in the frame.
The glass in the foreground is a mistake that could have easily been avoided by raising the camera a couple of inches.



A telephoto lens shows a detached view. Also, to change the relationship of elements in the frame the photographer would have to walk at least a few feet.

Focal Length and Sensor Size

If you have looked at the front of your lens, you may have been puzzled by some of the numbers given as focal lengths. The numbers printed on your lens might read something like 9mm–25mm. All wide angle? No.

Although the focal length numbers given to describe wide angle and telephoto lenses are important, they might not coincide with your camera. Here is why...

The numbers associated with focal lengths as described here originated from standard film cameras, where the film was 35mm in width (this mm size has nothing to do with lenses, just the film size).

The digital sensor that is the same size as this old film size is called a full-frame sensor, which is used in a full-frame camera. The descriptions of focal length are accurate with these full-frame cameras—the focal length numbers given previously are standard descriptions of wide angle, normal, and telephoto lenses.

But what happens if only a portion of that sensor is used, or if there is a smaller sensor (the same thing)? Suddenly, the same lens is a more telephoto lens. The angle of view is narrower and perspective is flattened. Nothing has changed except for the sensor area. The illustrations above show this. Same lens, but wide angle if all of the sensor's image is included, and telephoto if only a portion is used.

If you have a 50mm lens on a full-frame camera is a normal lens. But that same 50mm lens on a smaller APS sensor camera (like the one you probably have) will be a telephoto.





Both of these images are the same photograph. The second image is a crop of the first—in other words, only the center portion of the sensor is used for it.
Notice that the change in sensor area makes the second image have a narrower field of view and the flattening effect of a telephoto lens. In other words, the same image is now a telephoto.
The astute reader may question why depth of field is left out of this particular discussion. That will be explained in a aptly named later chapter.

SENSOR SIZE & FOCAL LENGTH

The red frame bordering the image at left is the coverage of a wide angle lens on a full-frame sensor. With smaller sensors, the same lens becomes more of a telephoto.

Although all of these were taken with a 35mm lens, the effective (equivalent) focal lengths differ because of the varying sensor size.

You can mimic a more telephoto lens by cropping your photographs like I have done in these examples. You will get lower quality, but if you have a larger sensor and are just posting a small image in an email or web page, you might find this useful.





35mm focal length



75mm effective focal length



150mm effective focal length

So, you have two cameras with two different size sensors, and on both 50mm is printed as the focal length on that lens. On one camera the lens will be a telephoto, and on the other it will be a normal lens. Confusing!

Compounding the problem is that sensors come in many different sizes (more than the common sizes described in this text), so there is no standardization except for the traditional film (and full-frame sensor) standard size that has been in place for over 75 years.

Full-Frame Equivalent

The solution to this focal length number problem is fairly inelegant. In descriptions of lenses there will be what is called a full-frame equivalent, equivalent, or a description which includes the old film width of 35mm. It will state the focal length of the lens as if it were on a full-frame camera.



Focal length at top and full-frame equivalent (here noted as Focal Length in 35mm film) as reported in Adobe Bridge.

Another way of telling lens and camera buyers the equivalent focal length is by reporting a focal length multiplier for a camera with a sensor smaller than full-frame. So, for a Canon camera with an APS-C size sensor, the multiplier is 1.6. Which means you multiply those numbers on the lens (the actual focal length) by 1.6 to come up with the full-frame equivalent (a number that makes sense). For example, a lens which is 50mm when used on a full-frame camera becomes an 80mm (50 x 1.6 = 80) slight telephoto on an APS-C camera.

To simplify all this is, just remember that only the equivalent number of the focal length really matters. And those are the numbers that are defined at the beginning of this chapter.



This camera lens is marked as a 18–55mm zoom. It is being used on an APS-C camera, so the effective focal length range is 29–88mm. If this lens was on a camera with a larger sensor, the equivalent focal length range would be the same as the actual focal length range.

Why Not Have Sensible Numbers?

The primary reason they don't print effective focal lengths on lenses is that the same lens might be used on different cameras that have different size sensors. I used to use a 17–40mm lens that acted like a wide to slight telephoto on my APS-C size sensor camera. When I changed to a full-frame sensor camera, that same lens suddenly became a wide angle zoom. So which numbers should be printed on the lens?

Digital Zoom

If you have ever zoomed in (telephoto) with a cellphone camera, you probably noticed how bad the quality of the photograph was. That is because most cellphones use a digital zoom—the lens doesn't change, but instead it only uses part of the (already tiny) sensor to make it telephoto. You should know how that works if you understood the previous explanation.

Other cameras also have digital zooms. If you see one on your camera, don't use it—you can always crop the image later and come up with exactly the same image.

Prime Lenses

There are lenses available that are not zoom, but instead have one fixed focal length. These are called prime lenses, and they come in many different focal lengths.

More Focal Length & Perspective

It is not really focal length that controls perspective. Rather, it is the distance of the camera to the subject. If you have a person around, you can sort of verify this: Cover one eye and put the other eye very close to the person's nose.

Our brain compensates for perspective, but if you put your eye close enough, even your mighty brain can't compensate that much, and the nose will look bigger.

You may have seen the opposite effect when you were younger and had a pair of kid's binoculars. How disappointing it was to find they didn't have any real lenses in them, and a paper towel core worked just as well.

If you don't remember, go get a paper towel core and look through it. Everything really will look closer and perspective will be flattened. This is also why the moon looks bigger (optically it is no bigger) when it is closer to the horizon.

But, wide angle lenses allow us to get closer and telephoto to get further away, so for all practical purposes, they do change the perspective.

Zoom Range

If you want a camera with a very large zoom range in a compact and inexpensive package, you have to buy a camera with a small sensor size.

There are many reasons you may want a prime lens. They are sharper, lighter, smaller, more dependable, have less flair, less image distortion, and allow you to take photographs in lower light.

The fact that prime lenses are so much better is testament to the fact that the versatility of a zoom lens is important. Also, modern lens designs and computers have minimized the disadvantages of zoom lenses. For example, plastics have made zooms lighter, more accurately ground lenses have made them sharper, and corrections for many lens distortions are readily available in most image editing programs.

Before computers I used only prime lenses. Now I use a zoom lens quite a lot. Having all those focal lengths in one package is very handy, especially because changing lenses lets dust get on the sensor.

Still, you may need a prime lens for a variety of reasons such as enlarging a distant subject, shooting in low light, or having a compact lens.

Now Go Shoot

That zoom lens on your camera is a versatile instrument. Take photographs using different focal lengths to understand how perspective changes. Which focal length do like best—wide angle or telephoto?

Look at what is happening to the background when you use different focal length settings. Do you want the background to be detailed, or do you want to blur it into a pattern by using a telephoto setting? Try cropping an image to mimic a more telephoto lens. Does it maintain quality?

EXPERIMENT

Take two (or more) images. Both should be head & shoulder shots of the same person done at the same time. Include a background like a building or trees.



Valentina Vasileva, wide angle (top) and telephoto (bottom)

The only difference in these two photographs will be the focal length at which your lens is set. In one it should be set to the widest wide angle you have, and in the other it should be set to the other end of the zoom range at the longest telephoto.

You will have to move forward or back to get the same head and shoulders shot at different focal lengths! Some lenses for cameras with smaller sensors are a bit ridiculous at how telephoto they get, so if you find you have to move back too much, turn it to less telephoto.

To get the best comparison for perspective, make sure the head size is the same for both images. Take a mental measurement from the top of the head to the bottom of the chin and try to duplicate this in your comparison photograph.

To get the best depth of field comparison, make sure you have a background that is fairly distant from the subject. You could even try to include things at several different distances as in the images on the this page.

You should notice two differences in your images from this experiment. First, the perspective will be stretched with the wide angle and flattened with the telephoto settings.

Second, the amount in focus will be less with the telephoto. Assuming your focus was on the face, the background will be more out of focus in the telephoto image.



Natasha Willey, wide angle (top) and telephoto (bottom)
A lens commonly used for portraiture would be a focal length in between these two.

Focal Length Questions

What kind of lens has a focal length? (trick question)

What is the distance of the sensor to the center of the lens when focused at infinity called?

What type of lens has a variable focal length?

What is the (full-frame equivalent) focal length of a normal lens? A wide angle? A telephoto?

What lens (or zoom setting) gives you a wider field of view? A narrower field of view?

What lens (or zoom setting) stretches perspective? Which flattens perspective?

What photographic term refers to the amount in focus?

Which focal length gives the most depth of field—50mm or 100mm? The least depth of field?

Which type of lens is physically very long?

With the same focal length lens, what sensor size will increase the effective focal length?

What does using the digital zoom use only part of?

When should you use a digital zoom? (trick question)

What is a lens without a zoom setting called?



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5.1: 5PH COLOR

When I learned photography, it was a black and white world. Of course, there was color photography (it has been around in some form since the 19th Century), but before digital it was a stub-born beast where extreme measures were needed to get the color to do what the photographer wanted. Outside of the commercial photography I did, color held little interest. I rarely started up the color processor (be glad you don't know what this is) for my creative work. There were creative photographers who worked with color (and some did it very well, as seen by the links in this chapter), but black and white was the norm.



This changed with digital photography as the computer allows incredible control of color. Now most of what I do is color, and I have lost much of my ability to see in black and white. But I still learned in black and white, and it still offers things I have never been able to do in color. Black and white abstracts an image—takes it out of this world and makes another one. This can be very very nice. On the other hand, color helps distinguish things, so a more complicated image can retain its definition and help keep it from sinking into chaos.

Even though color gives more options these days, there are still problems. For instance, if you pull up the contrast in an image, the colors get more saturated. Pull the saturation down and it looks unnatural. The problems are more perceptual problems than technical, but they are still problems. And with color in photographs it still feels like the control is awkward. While one can easily run an Instagram filter on an image or jack up the saturation to look like a hip advertisement from yesteryear, it is incredibly hard to get just the right blue to go with just the right orange. Sometimes it feels like working with a very small box of crayons. It is enough to make one want to paint instead of photograph.

But with limitations come opportunities. Both before and after digital photography many photographers have pushed the limits of interpreting color. **Olivia Parkers'** color palettes make me weak at the knees. **Sandy Skoglund** uses color in obvious and humorous ways. **Joel Sternfield** and **Stephen Shore** manage to find colors in the world that jibe with the rest of the image. **Loretta Lux's** painterly pastel images reinforce the soft but detached world she presents in her portraits. **Elena Dorfman** and **Rachel Herman** use color to draw you into their images. **Julie Blackmon's** color work is cinematic and **William Eggleston** uses color to reinforce the strangeness of his vision. For these photographers (and of course others), color is not just incidental, but used in very purposeful and masterful ways.

5.1: 5PH COLOR is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

5.2: 5CR CURVES

The Curve Panel

Directly below the basic adjustments panel is the curve panel. It will be easier to see if you collapse the basic panel by clicking on the name.



Adjusting Curves

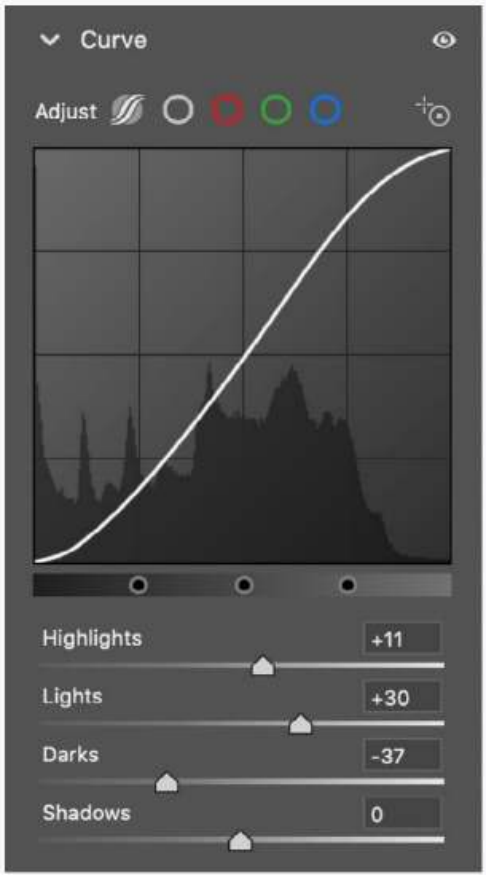
When set on Parametric Curve (red arrow), the targeted adjustment tool allows you to select individual tonal ranges in the image and make them lighter or darker.

You can use the sliders to do this or drag directly on the curve overlaying the histogram (there is that histogram again). You can also drag left and right on the tones of the image itself if you turn on the Targeted Adjustment tool over the right side of the graph.



Curve adjustments have a different effect than the adjustments in the basic tab (highlight, shadow, whites, blacks). In short, adjusting the curve will generally give a more naturalistic look, but also can make the image look flat (low contrast) in areas.

You can also change the extent of your tonal adjustments (highlight, shadow, whites, blacks). Click and drag the three small circles right at the bottom of the histogram.



Adjusting the curve is probably something you will do after you make the basic adjustments. Remember you can easily compare your curve changes by pressing and holding on the eye icon at the top of the panel.

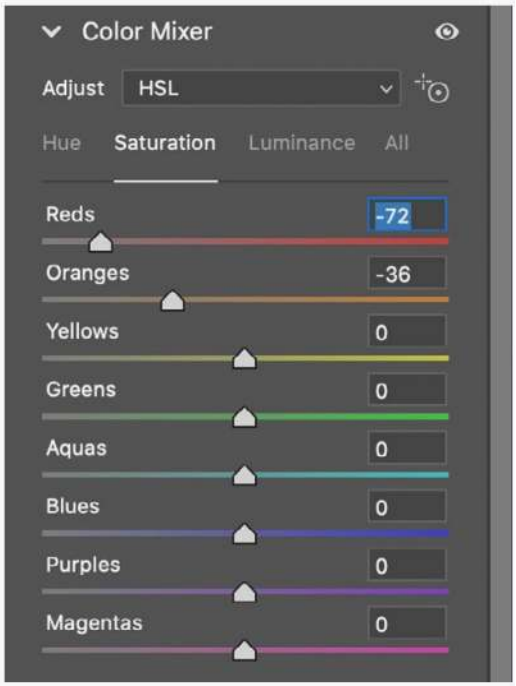


By clicking the Point icon over the histogram (red arrow) you can free-edit the curve. This is somewhat tricky and because of this has limited utility at this point. Still, try it.

You can add points by clicking on the line and remove them by double-clicking one or selecting one (it will turn dark) and hitting the delete key.

Although the point curve is more difficult to edit, it is very powerful. Playing with it can show you the extent (not the refinements) of the adjustments possible.

You can also adjust the three color channels individually, but it is my fond hope you will not need to any time soon.



Adjusting Discreet Colors

With the Color Mixer panel (below the curve and basic panels) you can also adjust discreet colors in your image. Like in adjusting curves, you can drag the sliders or use the Targeted Adjustment tool by clicking and dragging on an area in the image with the tool set to Hue, Saturation, or Luminance.



Hue: Allows the shifting of the color to another similar color.

Saturation: Controls the intensity of the color.

Luminance: Controls the brightness of the color.

The images at right show some of the controls for adjusting colors in Camera Raw. Typically, the controls are used more subtly to correct skin tones, sky color, and over or under-saturated colors.



When you choose the B&W button at top of Edit, the color panel changes to *B&W Mixer*. This allows you to make individual colors darker or lighter. Here the blue is turned down to darken the blue sky.



Gabrielle Calease Fox (original image)



Green hue, saturation, and luminance increased, blue saturation and luminance increased.



All colors except green and blue desaturated.

CURVES

Using the parametric curve to adjust tones is an alternative to using the controls discussed in a previous chapter. It is really handy because you are actually editing the histogram directly.

Unfortunately curves don’t always help you if you are also using the highlights/shadows/whites/blacks controls since they somewhat duplicate their functionality, but in an entirely different way.

Play around with the parametric curve to see if you like the way it works. Try it on several different images. It may work great for you for small adjustment, but the other controls may work better for large adjustments. At the very least remember them so that you can try them again on an image you can’t get just right.

COLORS

Color adjustments are essential. Practice them, play with them, and remember them.

Although at first these adjustments may just seem like fun because you can change your blue car into a green car, in reality they are very useful for tweaking the color of everything. Getting that skin tone just right. Adjusting the color of the sky that your camera got wrong.

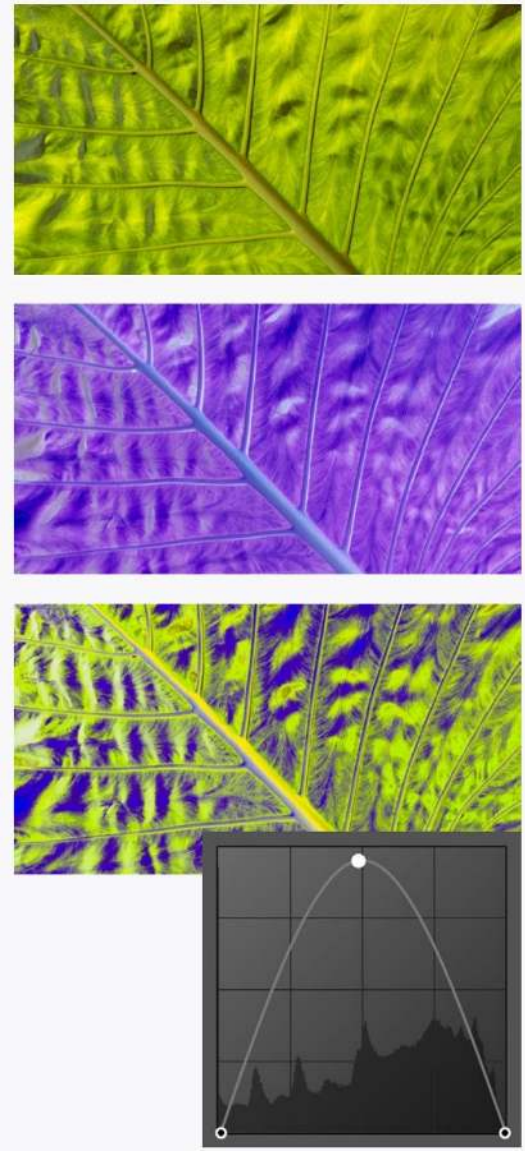
So play now, but remember these controls. You will need them if you care about good images. Modern cameras are pretty good with color
in many situations, but they often need help with interpreting that color. And color in a photograph is not reality, but an interpretation.

POINT CURVE

Mess around with the point curve. The worse thing that could happen is that you understand image tonality a bit more.

The illustrations to the right show three different curves. The first is the unadjusted image. For the second image the tones (and colors) were reversed by dragging the lower left of the curve to the top left and the lower right to the top right. The curve for the last image is shown below it.

Point curves are usually used for fine adjustments to tones (and colors). I doubt that you will need or want to do this right away, but playing can help you understand how the point curve could be an important advanced control.



CAN YOU...

Use the targeted adjustment tool on your image to adjust the parametric curve sliders to improve and image?

Change the extent of the four tonal areas on the parametric curve?

Add, move, and delete points on the point curve?

Understand what hue, saturation, and luminance is when referring to a color?

Adjust the hue, saturation, and luminance of individual colors in an image?

Make an image black and white and change the tonality of the original colors?

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6: Exposure

Without light, there is no photography. This chapter explores how light interacts with your camera, and explains some controls that will help you get technically better images.

Histogram

A histogram (at top right) is a graph which shows values and frequency. In photography the values are the brightnesses of the pixels from dark on the left to light on the right. The frequency is the number of pixels of each brightness, and is represented by the height of the graph. The more pixels of a certain brightness, the higher the line on the graph. When you put all the brightnesses closely together you get what look like the typical hills you see in a histogram.

Histograms are important because they give a definitive view of the tonality of an image. Unlike an image, a histogram is undistorted by such things as the light with which you are viewing the image, screen brightness, and tonal relationships. They can be found in almost any image editing programs and on the camera itself.

You can set your camera to display a histogram either before the image is taken and/or during review of an image. If you set it to show while you are shooting you get instant feedback of your tonality and exposure, but it also somewhat limits the view of your scene.



As covered in the Sensor chapter, when light hits a sensor, brightnesses are assigned numbers, which are called levels. No light hitting a pixel on the sensor registers as 0, which will be rendered black, 126 is a medium value, and 255 is white. The left side of the histogram is 0, or black, and the right side is 255, or white. The middle parts of the histogram depicts the gray or medium tonality areas.

No tones lay outside of the histogram, although one exception to this will be discussed in a few pages.

Using histograms to assess the tonality of images takes practice, but the fundamentals are straightforward.



TOP Histograms show the number of pixels in height and brightness of the pixels across from black on the left to white on the right. BOTTOM An unlikely four-value image with its histogram below it. The levels (values) from left to right of both are 0, 85, 170, and 255.

This numerical scale is standard across cameras and computer programs. Many histograms overlay graphs for each of the three color channels (RGB).





For example, if you see a histogram in which the hills are to the right (especially if they are cut off), it is probably an indication of overexposure, or too much light hitting the sensor. The tones that are cut off are gone, and no amount of image correction will bring them back.



On the other hand, if the hills are only on the left (especially if they are cut off), this probably indicates underexposure, or not enough light hitting the sensor. Again, the tones that lie outside the left of the histogram are lost.



A correctly exposed image will have a histogram where all the tones lay contained in it. For many subjects, the tones will also spread across a large portion of the histogram.

This is a good a time to note three more terms that photographers use. Highlights refer to the tones that lie on the right side of the histogram. In your image they are the lighter areas. Shadows are not just areas in the shade, but are any darker areas.



Review and/or taking image showing histogram in the upper left of the image. This histogram clearly shows the shadow areas (darker pixels) of the leaves on the left of the graph and the midtones (gray pixels) of the sky in the middle. There are few highlights (the clouds) in this image.
More importantly, all tones appear to be confined to the histogram and are spread across it, indicating the correct exposure.

These lie to the left in a histogram. Finally, midtones are the areas towards the middle of the histogram.

The most common exposure mistake happens when the highlights are not contained in the histogram, but lie outside the right of it. These lost tones, where a number of different levels are defined as 255, are called lost highlights. Because the highlights are clipped from the histogram, this is also called highlight clipping. The lighter areas of the image will have no detail or differentiation of tones. Often they are described as blasted out highlights. You have probably seen these unpleasant bright areas in images from your cellphone camera. Not only are the tones compressed, but colors also tend to go awry.

Cameras also include a feature which provides a stronger warning than the histogram for lost highlights. In the review image the levels that are white or lighter (level 255) will flash a color. This is why you often see photographers looking down at their review image—not to see if they were pointing the right direction, but to see if they have any lost highlights.

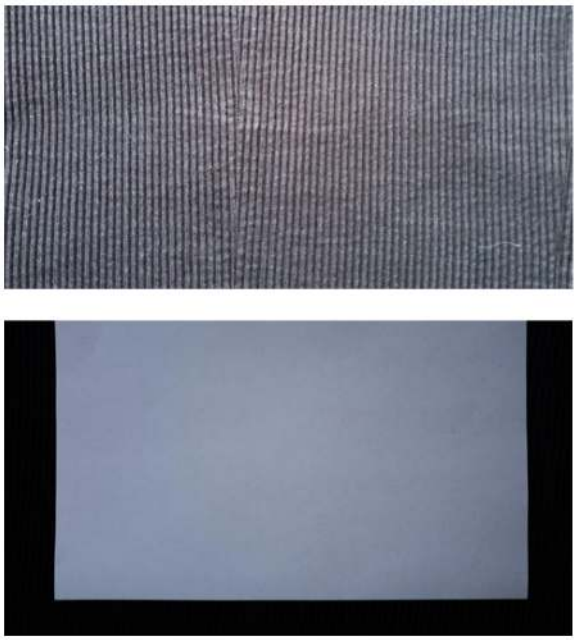
When tones are lost off the left side of the histogram it is called shadow clipping. For a variety of reasons this presents fewer problems than highlight clipping.



Camera review image showing highlight clipping with a flashing red area.

Exposure

When you take a photograph, your camera assesses the amount of light coming from the subject and adjusts the aperture (the quantity of light) and shutter (the time the light is let in) so that the right amount of light falls on the sensor, ensuring that the histogram will contain all the tones necessary.



These two photographs were taken on automatic exposure with no corrections. The top one is a dark black corduroy jacket and the bottom is a white sheet of paper laying on the same jacket.
The top image is overexposed (too much light) and the bottom one underexposed (too little light).
You can do this same test and get the same results with any camera—even a cellphone camera.

For many photographs this works great, but for some, it doesn't. This is because your camera does not know what you are taking a picture of.

If the camera sees a lot of dark when you are taking a picture, it will think think there is very little light. Therefore, it will allow too much light to the sensor, and the photograph will be overexposed, or too light. Like in the top right illustration of black corduroy.

Another example of overexposure might be seen when taking a picture of a spotlit singer from far away. The camera sees all the dark around the singer and so assumes the subject is dark. In trying to make that dark normal, the singer will be rendered too light—no more than a white blob whose levels (brightness) would be far off the right side of the histogram.

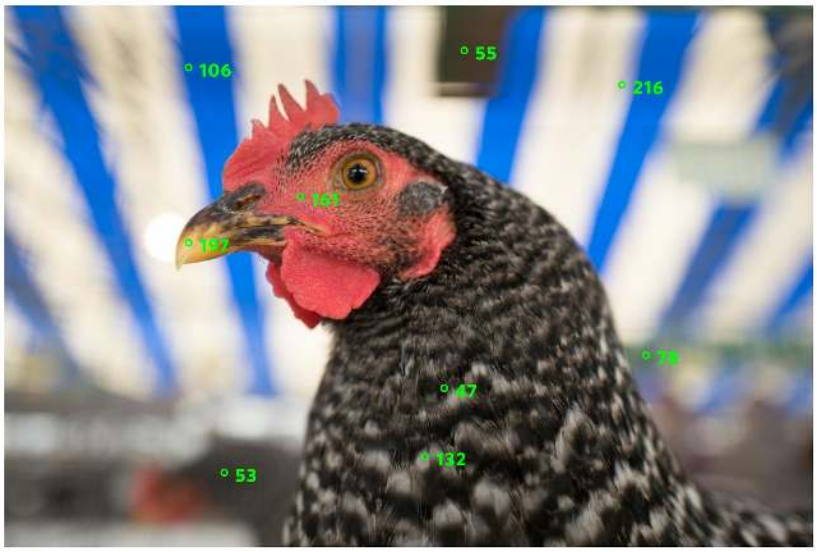
If, on the other hand, the camera sees a lot of lightly colored things, it will try to darken them to normal and the resulting image will be underexposed, or too dark.

This can be seen with the paper in the illustration on the previous page or a snowy scene. With snow, all the camera sees is a lot of light. So it will let in too little light and underexpose the picture.

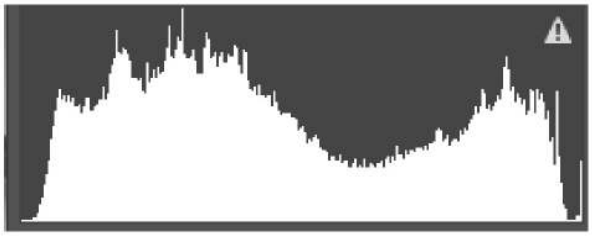
Neutral Gray

Any time a photograph is taken, the camera is actually averaging all the tones in a scene to a neutral gray value, which looks somewhat like the gray below.





A typical scene in which there is a full range of levels (tones) distributed evenly. Some representative levels are shown in green.
The histogram below confirms the fairly even distribution of tones in this image.



In a typical scene there are both lighter and darker areas. The camera averages these together and makes that average neutral gray. In the resulting image their respective brightnesses are maintained so the image has an exposure that is usable. The darks are dark and the lights are light. As you get more experienced with photography, you will find that many times the most interesting images are not of typical scenes, and so the automatic exposure often (or at least sometimes) needs to be overridden.

Exposure Correction

Fortunately it is fairly easy to correct exposure problems if you have the time to take another photograph: After you take a photograph, look at the histogram in the image review. If the hills are not contained in the histogram (image is too dark or too light), you can correct it and take another photograph.

This correction is simple. Somewhere readily accessible on your camera (refer to your camera's instructions) is an adjustment for Exposure Value (EV) Compensation or

Exposure Compensation. It will be labeled with a +/- symbol or with EV. If your first picture is underexposed (too dark), adjust the EV scale so that the pointer is in the plus range, and if overexposed (too light), turn it to the minus range, then re-shoot the scene at that setting.

You can repeat this process using different EV corrections until you get the exposure correct. You should depend mostly on the histogram on the camera's review screen—if the hills are to the left, the image is probably too dark, and if they are on the right, the image is probably too light. If all the tones are within the histogram, the image can be successfully adjusted later on the computer. Using the histogram in this way is a much more accurate way to assess exposure than using the camera's review image.

These EV compensation numbers actually have meaning—each number lets in twice or half the amount of light. In photography each one of these numbers is called a stop (remember?).

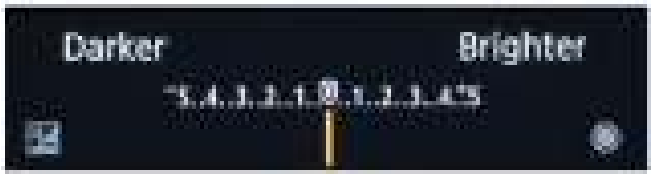
If you are having trouble finding the EV scale, it is in reach of the digits on your right hand. Cameras have a wheel dedicated to it or a button that when depressed makes the main wheel function as the EV compensation. Most photographers change the EV compensation number frequently. As you get used to using it you will pretty much know how to compensate your exposure before you even take the photograph.

There is another EV adjustments for the flash that has a little lightning bolt next to it. That is NOT the one you want to adjust, as it only adjusts the brightness of flash photographs.



The EV (+/-) button is held down while main control wheel is turned for EV adjustment. Some cameras have a second wheel that is dedicated to EV changes.

A typical EV scale in the viewfinder or on the back viewing screen. This one allows 5 stops of correction in either direction.



EV Numbers

An Exposure Value is actually a standardized number which defines the amount of light available relative to how much light the sensor needs.
Since these numbers do not help increase understanding nor do they show up anywhere on most digital cameras, they are of little utility.

Bracketing

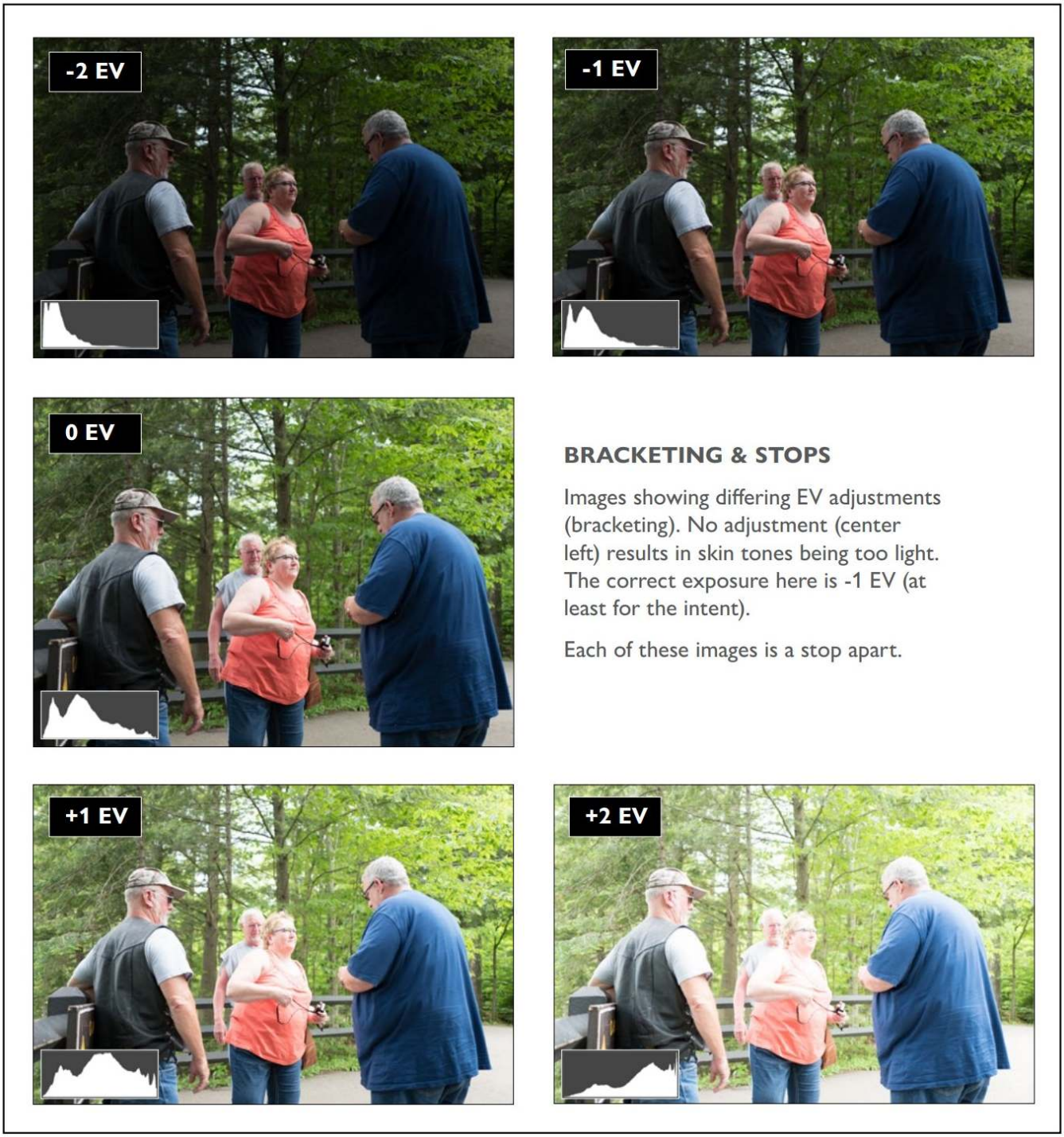
A way to get the correct exposure every time is by bracketing. To bracket a photograph means to take several shots, all at different exposure value compensations (EVs). If you have plenty of time, you can take five images of the same thing, changing your EV to a different number with each. A typical sequence is -2, -1, 0, +1, +2.

Most cameras will also allow you to bracket shots automatically. Deep in the menu is where you will find Auto-Bracketing. This directs the camera to take multiple photographs in rapid sequence, all at different EV values. I have never found this particularly useful, but in certain situations it could be.

Bracketing is something you should try, but in taking photographs you can evaluate your histogram and retake as many shots at as many EV compensation values as necessary to get the correct exposure.

And if the subject is fleeting and you can only get one or two shots, then you don’t have time to bracket anyway, even with auto-bracketing.

Besides showing bracketing, the illustration at right should also help you see how much exposure change a stop is.



Metering

To determine how much light to let in for the correct exposure, cameras have exposure meters (also called light meters) built into them. These are like thermometers, but measure the amount of light instead of the amount of heat. The meter evaluates the amount of light so your camera knows what aperture and shutter speed (overall exposure) to use.

In other words, the exposure meter is the tool the camera uses to take all the brightness reflected by objects in a scene and average them to neutral gray.

Following are several different metering modes you can set your camera to use (again, see your camera instructions).

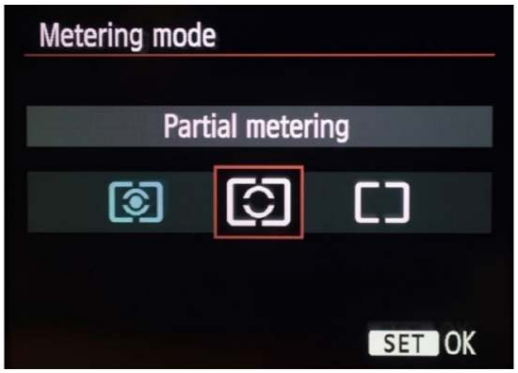
Evaluative metering (also called multi-point, matrix, and other things) tries to figure out what you are taking a photograph of by the type of light pattern it sees. While it works well with a predictable scene such as a portrait or group of people, it will revert to another metering mode with an unpredictable scene.

Center-weighted metering sees the light towards the center of the frame most—based on the assumption that you will put the most important part of your subject near the center of the frame. So, if you are taking a picture of a person centered against a dark or light background it will not be fooled into trying to make that background a normal exposure. This center weighting is usually not very heavy, so it is like averaging the entire scene's light.

Spot metering (also called partial metering) only looks at the center of the scene to figure out the exposure. Of course, this assumes that you are putting the most important thing in the middle of the frame. And while sometimes you might, hopefully you are trying to compose differently.

There are additional metering modes in many cameras. You can read your camera's instructions about these to see if they would be of use as a general setting or in specific instances.

Each metering mode has its benefits and drawbacks. Now that you know the basics of how they work, you can pick the one you think might be best for you, then use it to get familiar with how it works.



This menu has three metering modes available.

Histogram Evaluation

Why don't cameras evaluate the light using the histogram? Many do have this capability, but only to some extent and not with RAW format images.
Probably this capability is limited because at some point too much automation will work against getting a good exposure. Histograms really need a human to interpret them.

But remember that whatever metering mode you use, your camera meter only knows neutral gray. It does not know what you are taking a photograph of or how to interpret it. On the following pages are some examples that will help you understand this.

Of course you cannot evaluate your exposure with every photograph you take. If you have less than a second to secure a scene, you are not going to be changing the EV compensation number, because by the time you do, your image will be gone.

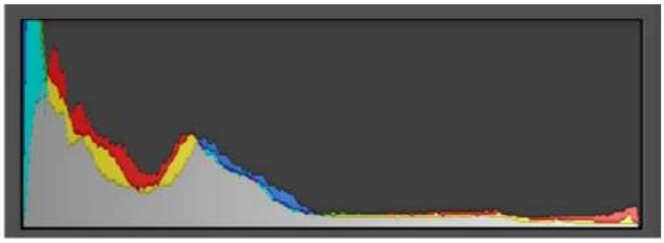
Exposure Lock

Most cameras have a provision to lock the exposure when taking a photograph. For instance, if you are taking a photograph with a bright sky, you can point the camera down so that it doesn't include the sky, lock the exposure, and then frame it with the sky. In this way the bright sky won't make the ground too dark.
While you might find this to be a useful control, it can also confuse things. Using the EV compensation instead is simpler and works in more situations for most students.

Also, you are not going to be able to use the histogram with every photograph you take. But whenever you can, get used to using it on your camera's review and in your image editing application. It takes practice to know how a histogram reflects the actual tones

of an image.





The color histogram seems to indicate the image above it is too dark, but the exposure is fine for this predominantly dark subject.
The histogram also shows lost (clipped) highlights, and although there are, they are inconsequential.
With practice it becomes easier to evaluate images using their histograms.

Exposure Meters

You can buy exposure meters that are separate from the camera. These read the amount of light and tell you the correct settings for shutter speed and aperture at a given ISO.
Reflected-light meters evaluate the amount of light reflected from the subject in much the same way your camera does.
Spot meters read light coming from a very small portion of the subject. This is good for small bright things like a singer on a stage. Also, with several readings you can predict what tone each part of any scene will be.
Incident meters read the light falling on the subject. In this way they are very accurate, but awkward to use since they are held at the subject.
Flash meters read the light coming from flashes, something that your camera's meter cannot do.
With the instant feedback available in digital cameras the need for these meters is narrow.

EXPOSURE COMPENSATION EXAMPLES

There is no metering system in the world that would know that the hens in the foreground should be dark and the people in the background should be properly exposed. The EV compensation for this image was -2 EV.

The histogram of this image shows a lot of very dark areas (large hill on the left of the graph).





High contrast scenes, like the images below, are impossible for a camera meter to figure out, although you might luck out and the image will be correctly exposed.
If you are not lucky, you have to guess at an EV setting and then try different ones based on your image review and histogram.









The left image is without EV adjustment (taken as the camera meters it). The meter sees a lot of dark and so makes the image lighter.
The right image is corrected with EV-2.





The left image is without EV adjustment (taken as the camera meters it). It sees all the light and so makes the image darker.
The right image is corrected with EV+2.

RAW Files

All this about getting the correct exposure takes us back to RAW format files described in the Sensor chapter. When your camera is set to save images in RAW, you actually do get some tonality before and after the tones on the histogram (0–255). How much tonality you get and the quality of that tonality depends on your camera model.

The earlier bracketing example is a bit of a fake. The image was not bracketed in the camera (it was shot at EV-1), but depended on the RAW format to simulate bracketing in

Photoshop (the clue is that bracketed photographs can’t be taken that fast, nor will strangers freeze mid-stride while multiple photographs are taken). But the effect is visually identical to having bracketed the images in the camera.

If you can correct exposure in an image editing application, why bother with it in the camera? There are several reasons, which can be distilled in one statement (leaving out the complicated ifs, ands, or buts): The best image quality will be found with the tones

that are within the histogram. Tones (and colors) outside the histogram are just not as accurate.

THE LIMITS OF RAW



The two images on the left are uncorrected details of RAW images. The top image is overexposed and the bottom image is correctly exposed. In the bottom right image the exposure of the overexposed image has been corrected in Photoshop Camera Raw.
Notice that this corrected image has severe tonality problems in both the lightest areas and the color of all areas of higher brightness. This is an extreme example, but the moral of the story is that the best exposure is the one that needs the least correction in processing. Even with RAW images.



Correctly exposed



Over-exposed, then corrected

RAW v JPEG

Just the fact that you can adjust the exposure to some extent with RAW files is a compelling reason to use RAW format. But also remember that white balance can be done after the fact with RAW images, but not with JPEG. These are the reasons RAW has been discussed in this text several times and the primary reason I am repeating it here.

But, there are still reasons to sometimes use JPEG. JPEG files are much smaller than RAW, so you can fit many more on a memory card. This might be useful if you are taking a picture sequence which includes hundreds of photographs or making quick images that do not need much quality.

If you are using your camera to communicate with your phone over WiFi, most phone and tablet applications use smaller JPEGs to ferry images back and forth. This is a reason most cameras have the ability to save both a RAW and a JPEG together on the memory card.

Also, if you want to put images directly from the camera into a word processing program or social media you need JPEGs. RAW format requires a photo editing application that can decode the RAW information, so saving as JPEG (or RAW+ JPEG) will allow you to skip the middle-man application.

My suggestion is to always save your camera images in RAW, since you can easily generate a JPEG if you need it. If you find you need JPEG earlier in the process (such as directly from the camera), use RAW+JPEG.

One final note on RAW format files. They can be edited in many different applications, from Apple Photos to Affinity Photo. But each of these applications include the edit instructions in different ways, so you cannot transfer your RAW files from one

application to another and retain the changes. Even a change in Apple Photos will not be shown if you view the image in Preview or in the Mac Finder as thumbnails.

Latitude

How many tones lie outside the histogram with RAW files is called exposure latitude.
In general, dark tones beyond the left side of the histogram will get noisier if they are recovered, and tones beyond the right side of the histogram start to shift colors and develop uneven tonal transitions. How much and at what point these effects happen and how many tones can be recovered is dependent on the model of the camera.



The number in brackets is the approximate number of photographs that can be shot on a specific memory card. With the JPEG setting at the bottom (same image size), that same card will hold about seven times more images.

The exception to this is with Adobe Photoshop Camera RAW and Adobe Lightroom. These two programs use the same language to describe RAW changes, and are synchronized with every update to have exactly the same features. Make a change in Camera Raw, and those same changes will be shown in Adobe Lightroom and mobile versions of Lightroom. The changes will even be shown when viewing images using Adobe Bridge.
JPEG Images

Even if you don't save JPEGs directly from your camera, you will obviously be using them at some point. JPEG is the format for communicating on the screen. The file sizes are small and the images can be placed in any application, saved to social media or emailed. Many of the images in this book were resaved as JPEG.
Resolution

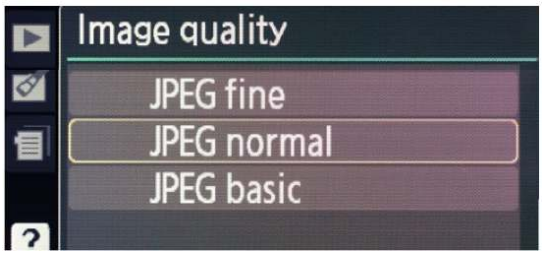
If you set your camera to save JPEGs, one of two options is how many pixels the image will have, or its resolution. The more pixels you save the image with, the more you can enlarge it (either on the screen on in print). Resolution in this case is sometimes stated as image size.



When saving a JPEG from an image editing application you have this same control over resolution using the image size menu. Many images in this book were saved at 2000 pixels wide. They were then automatically resized to an optimum resolution when the book was converted to the PDF you are now viewing.

Compression

The other control with JPEGs is compression, which is also called quality. When you save an image as a JPEG in your camera, it reduces the file size by discarding image information that is less important in viewing. Less compression (higher quality) means less information thrown out.





Person dancing with a deer. Original image resized to a resolution of 400 pixels across.



Resolution set to 100 pixels across (not enough!)

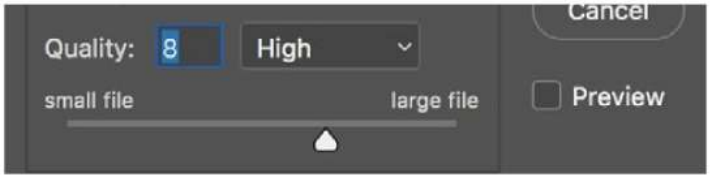
Publishing Resolution

When preparing for a printed publication, many people will specify image files that are 300 pixels per inch (ppi). This means that if an image is going to be printed 10 inches wide it should be 3000 pixels wide (10 inches X 300 pixels).

More compression (lower quality) means more information will be thrown out.

In an image editing program you can also choose how much compression you apply to a JPEG file when saving.

Generally this is with a slider that goes from low quality (small file size) to high quality (larger file size). High quality is indistinguishable from a file without any compression, but since every re-save of an image adds to the loss of quality you should save images you are working on in a format that does not discard information, like...



Photoshop Format

Although cameras do not save images in Adobe Photoshop format, it is a good format to save edited images in, especially if you import them into other Adobe applications such as Illustrator or InDesign.

Unlike JPEG, the Photoshop format will not decrease quality even after multiple resaves, and it will retain features such as layers and transparency that you may introduce using Photoshop (not the Camera Raw part of it) to edit your images. Of course, these abilities come with a drawback, which is larger file size.



Original image as seen on previous page



The image re-saved multiple times in JPEG with a lot of compression to clearly show what JPEG compression can do to an image.

Lossy Compression

JPEGs are amazingly good at reducing the file size of images by discarding information that is not readily seen. For instance, JPEG discards more information in the dark areas of an image because that is where the human eye sees less detail. Since information is lost in the saving of the image, it is called lossy compression. Photoshop format also compresses the information in images, but no information is thrown out in the process, so it is called lossless compression.

JPEG compresses by first dividing the image into 8 pixel squares then evaluating the information in these squares. You might have seen these squares in over-compressed images. You can also see them subtly swimming around dark areas in movies on your TV. A common movie format, MPEG, uses the same compression scheme.



Detail of a dark area in an image (lightened and highly magnified) showing image before and after JPEG saving on low quality. The larger blocks on the right are not pixels, but the 8x8 pixel squares.

Three Useful Image Formats

	RAW (.CR2, .NEF, etc.)	JPEG (.jpg, .JPG)	Photoshop (.psd)
USE	Photographing	Photographing & saving from applications	Saving from Photoshop
WHERE	Camera only	Camera & apps on computer	Image processing apps like Photoshop
QUALITY	Best of all formats	Variable, usually lower, especially when resaving	Very good, no loss of image quality when resaving
FLEXIBILITY	Only open in a few apps	Open in virtually any app	Opens in some apps
ABILITY	Cannot save over original file	Saves only image information & metadata	Saves all Photoshop data, including layers and transparency.
FILE SIZE	Largest	Smallest (variable)	Medium
ADVANTAGE	Best way to save images in camera, since it saves many tones, and some even outside of image limits (after white, before black)	Best for final images needing small file sizes or ability to be opened in many applications, i.e. edited images to be sent to others, included on web page, or placed in another application (such as word processing)	Best for images that will be edited in Photoshop, sometimes best for images to be placed in other Adobe applications, such as InDesign (since Adobe programs can read things like transparency)

Some Other Image Formats

TIFF An old standard for any desktop publishing application GIF useful for animations or images that do not need a lot of tones or colors PNG is actually several formats in one that replaces JPEG and GIF in many uses, particularly the web, and has a few advantages PDF for sending to someone who wants a PDF (not much utility for images alone). There are many other image formats for special uses, such as HEIF and HEIC formats that some cameraphones use.

Now Go Shoot

Before you photograph, figure out how to how to activate the histogram on your camera, either while taking the image or reviewing it. Look at it with different scenes, and figure out what the histogram is telling you.

Take some photographs of mostly light and mostly dark subjects. See if you can start to predict how the camera will interpret the scenes tonally.

Review your images and the histograms after you shoot. Can you understand what is happening? Could the photographs been exposed better?

Try different EV compensations. Understand how a stop of exposure translates into the tones you see.

Choose a metering mode that seems to make sense for you, and keep it there. Then try changing it to another mode. Are your photographs exposed better?

Try filling the image frame with an evenly-toned subject such as an overcast sky. Is it rendered neutral gray as described in this chapter?

Perhaps try to intentionally underexpose and overexpose some images, such as in the following experiment. Can you make under and overexposed images as good as the correctly exposed images when adjusting them at the computer? What are the limits for the RAW images your camera produces?

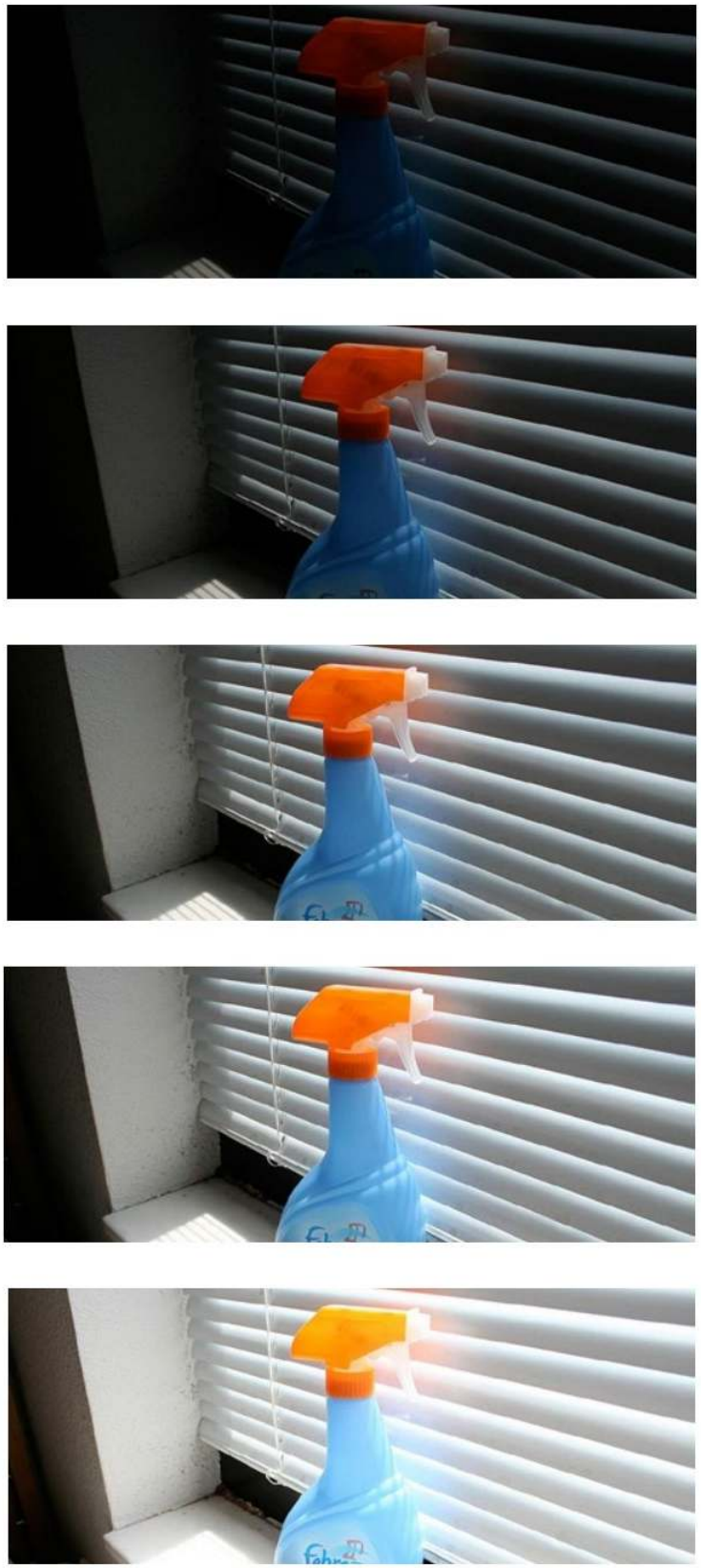
EXPERIMENT

Even though you may never feel the need to bracket exposures you take, this is a good exercise that will help you remember how to change the EV settings on your camera (something you should be doing!). It should also help you see how much change a stop makes.

With your camera set on P, you will find exposure (EV) settings that go -2, -1, 0, +1, +2 (there may be more).

Take the exact same photograph at different full stop settings (whole numbers). If you can't find your EV settings, you may be looking too far—they are very easy to change on all cameras.

Your bracketing sequence should show exposure changes in the same way as the images at right.



Ayako Shimizu, bracketing sequence from EV-2 on the top to EV+2 on the bottom (details)

Exposure Questions

What is the graph that shows the values of the pixels in an image or scene?

What are the numerical brightnesses in an image or histogram called?

What number (level) is registered by the sensor for no amount of light? For the maximum amount of light?

A histogram with the hills to the far left means the image is what? If the hills are to the far right?

What are the lighter areas of an image called? The darker areas?Highlight clipping can be indicated by what in the image review?

A photograph of a snowy scene with the default camera settings will be underexposed, overexposed, or correctly exposed?

What gray does the camera average all brightnesses to be when metering?

Why might you want to take another photograph after reviewing the image in your camera?

What is the setting you use to correct the exposure when taking a photograph?

What are the increments the EV scale uses?

What is the technique of taking the same scene at several different EV values called?

What device that measures light is incorporated into cameras? What metering mode tries to figure out what your subject is?

What metering mode mostly evaluates light in the center of the camera frame?

Which is the best type of metering mode? (trick question)

What file type gives you tonality beyond the limits of the histogram?

Where are the best tones or colors to be found relative to the histogram?

What file format saves the smallest files?

What file format will almost all applications recognize?

What term refers to the number of pixels in an image?

What term refers to the quality of the pixels in an image?

Besides RAW, what other file format does not decrease the image quality when saving?



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6.1: 6PH ON THE STREETS

A dozen or so years ago I was in Las Vegas returning from a trip to Death Valley. The evening was cool, the street was bizarre (if you have been to Vegas you know what I mean). I started taking photographs, shooting without looking through the viewfinder in hopes that something interesting would appear in the resulting images. I shot about 350 photographs in a few hours, really just to see what would result.

The results were impressive. Well, at least to me. The twenty photographs I printed described my impressions of a city filled with loneliness, posturing, decadence, alienation, excitement, lewdness, drunkenness. A topsy-turvey world seemingly playing a strange end-game.

Twice I have been back to Vegas, and twice I have tried to replicate and expand on that set of images. And twice I have failed. I have hundreds of bad photographs to prove it.





The technique I was using is from a genre of photography called **street photography**, where photographers just shoot what is around them on the street, often quickly and relying on plenty of editing to get a good photograph. This style started with little-known (then) photographers in the early 20th Century. Jacques Henri-Lartique was a young photographer who wasn't concerned with pesky things like composition. He just pointed the camera at the cool stuff around him. At about the same time Eugene Atget photographed the streets of Paris using very precise composition. Later, Helen Levitt took photographs which are sympathetic and feel honest to the people she met on the street.

Garry Winogrand is one of the later photographers who used this style of photographing. As proof of the power of editing, when he died there were about 10,000 rolls of his film that were not fully processed. **Lee Friedlander's** images have an accidental feeling to them, even though they are precise. **Bruce Davidson's** images are gritty and have a 1960s beat feel to them. For even

grittier stuff, look at **Bruce Gilden's** images. **Robert Bergman's** street photographs are intimate portraits of interesting people he meets on the street.

Disclaimer (of sorts)

Even though I have shoe-horned a lot of photographers into this text, there are many that are omitted, and admittedly, many misclassified. Some of those that couldn't quite get classified are definitely worth mentioning, such as the lush tones of **Ruth Bernhard** and the lyrical images of **Barbara Morgan**. **Keith Carter** and **William Christenberry** are known for photographs of the American South. **Duane Michaels** tells short stories through photographs, and **Bernice Abbot** is one of the history's great photographers.

There are many other well-know photographers. Some of them I have not included because they don't come to mind or I couldn't find readily accessible web pages of their work. Some others I didn't think they were appropriate for this text since their work is not as easily appreciated as the ones included.

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6.2: 6CR MORE LOCAL ADJUSTMENTS

In addition to the adjustment brush, there are two other local adjustment tools in Camera Raw. These behave the same way as the brush, and like with it you can define multiple areas with their own separate adjustments.



The Graduated Filter allows you to define an adjustment area by clicking and dragging in an image. This is helpful to do something like darken a sky. Where you first click is the extent of the fullest part of the adjustment, and where you drag to defines the area where the adjustment fades out (the feather). You can (now or later) move this adjustment or edit it with a brush, either removing parts from it or adding parts to it.



The Radial Filter allows you to adjust a circular or oval area. This might be used for making the center of an image lighter to emphasize it or to correct for dark edges produced by a lens (even though there is another control dedicated to this).

Like the adjustment brush, there is a feather adjustment for the effect, but unlike the brush, the effect does not coincide with the oval drawn. Fifteen minutes of playing around with this tool is worth more than all explaining that can be done here. Neither the radial nor the graduated filters do anything that the adjustment brush won't. But they do make some things easier.



The graduated filter used to darken the background and draw attention to the mired mare



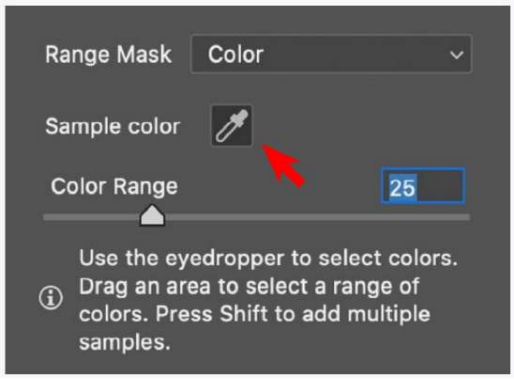




A circular radial filter used to make Capn' more obvious in the image

You may have noticed that you don’t have all the adjustments over a local area that you do for a whole image. One important thing missing is the ability to change just one color in an area the way you changed colors in an image.

The solution to this is near the bottom of all local adjustments. It is the Range Mask. After painting in an adjustment area (it can be really rough), you can limit that area to only work on a certain color. Set the range mask to Color, then with the eyedropper tool selected (red arrow) click the color you want to adjust.

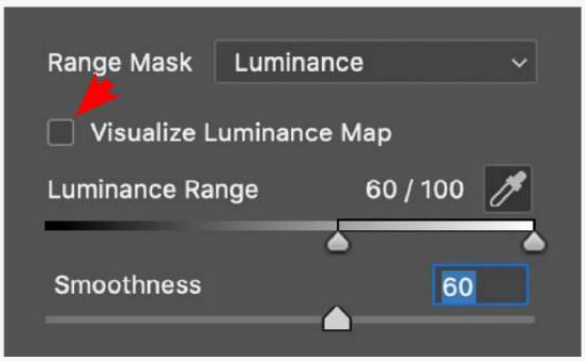


You can expand your color area by picking on similar colors with the shift key held down, and/or you can drag across an area with the eyedropper. After you select the color(s), use the Color Range slider to expand (or narrow) the range of colors selected.

The statue in the bottom image at right was very roughly selected and the white balance was shifted. That selection was then limited to the statue by shift-clicking with the eyedropper on several parts of the bronze.

Instead of limiting an adjustment brush to a color range, you can limit it to a Luminance Range (a range of brightnesses).

After you make your rough selection, drag the left Luminance Range slider to limit the adjustment area to the lighter areas, or the right slider to limit it to the darker areas. Experiment with this after you have made the adjustments you plan to make.



After your luminance range is picked, use the Smoothness slider to fine-tune the adjustment area (it acts to feather the selection).

In the bottom illustration the graduated filter was pulled over the top two thirds of the image and the sky was darkened. Then the left luminance range slider was pulled to the right until the adjustment did not include the foliage.

You can edit your adjustment masks even after you define a color or luminance range. Making the a mask visible using Visualize Luminance Map (arrow) and/or holding down the option key while moving the sliders may help you see what is happening while adjusting.



Original image



Statue and sky with exaggerated adjustments

MORE LOCAL ADJUSTMENTS

The graduated filter tool is the most used in my toolbox. It is simple, direct, and very quick to use. Try using it to darken skies or the edges of images.

Try editing your graduated filter area using a brush. Erase parts of the filter, periodically switching the mask (not auto mask) on to see where you are painting.

Use both adjustment brushes and the graduated filters on the same image. See how strong you can make the adjustments. I will be willing to bet that what you think looks a bit like a 'fakey' adjustment will be accepted by the viewer as unadjusted.

The radial filter is much less useful as an adjustment, but when it is needed it is great. Try lightening the area where a main subject is in an image. Try using it to darken an image's corners.

RANGE MASKS

Okay, I admit it, range masks are a little difficult considering how useful they are at this point. But they can be great in certain situations, so try them out. Then when you get to an image that really calls for them you are prepared to learn the finer details about how to use them.

Try to select different colors using the color range mask. Also try to use the luminance range mask to limit adjustments to one tonal area. Play with these controls. We are learning tools here, and the more tools you have the better you will be able to make improvements in the future when you need them.

CAN YOU...

- Use the graduated filter to adjust parts of an image?
- Erase parts of a graduated filter?
- Erase using auto mask?
- Use the flow tool to control how much to erase parts of the graduated filter?
- Use multiple graduated filters and edit them?
- Use the radial filter and invert the effect? (don't tell me you didn't see that option)
- Use the color and luminance range masks in conjunction with the adjustment brush and the graduated filter?
- Use the color range mask tool to limit an adjustment to similar colors?
- Select a range of colors with multiple samples or dragging through an area of colors?
- Use the luminance range mask to adjust only the darker or lighter parts of the masked portion of the image?

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7: Depth of Field

Controlling the focus in a photograph—what is in focus, what is out of focus, and how much so for each, is important. This chapter explains how to control focus.

In the Lens chapter the concept of depth of field, or the amount in focus, was introduced. The primary way of controlling depth-of-field is with the aperture.

Aperture (F-Stop)

In the general sense, an aperture is an opening. In photography, it is an adjustable opening at the center of the lens. Just like the iris in your eye, a smaller opening lets less light pass through the lens, and a larger opening lets in more light. Like adjusting a water faucet to vary the flow of water, aperture varies the flow of light.

With your camera in program mode, this aperture is controlled automatically by the camera, but it is often advantageous to control it yourself. This is because the size of the aperture also determines the amount in focus in the photograph.

The standard for describing the size of an aperture is a number that is called an f-stop. The lower the number, the larger the aperture. If this (lower the number the larger the opening) is confusing to you, just remember that it is backwards from what you might think it is.



Different f-stops with an antique lens from f8 at the upper left to f45 at the lower right. These are exactly the same in a modern camera, although the range of possible f-stops may be different.

While f-stop and aperture are fairly interchangeable terms, f-stop refers to the number, and the aperture refers to the opening. When referring to the relative size of the opening, the term aperture is used, as in a larger aperture. If you instead referred to a larger f-stop, there would be confusion since it is not clear if you are talking about the number or the opening.

Each model of lens has a different range of apertures (f-stops), but within that range, the numbers are standardized. So, just about any lens will have an f-stop of 8 (expressed f8 or f/8). This is a standard number. Another standard number is f5.6. This lets in twice the amount of light, or one stop more light (hey, here are those stops again meaning one half or twice the light). Conversely, f11 lets in one stop less light than f8.

Every photographer knows these numbers by heart, but don’t be too concerned about memorizing the actual numbers even though they will be referred to. Just remember that the higher the number (smaller aperture or opening), the less light—and that each standard number change is a stop change.

Plane of Focus

If you have your lens at the largest aperture and you are focused on something ten feet away, everything that is ten feet away will be in focus. Anything that is more or less than ten feet away will not be in focus. You can think of focus as a large plane, in this case ten feet away from the camera. Or like a large sheet of glass parallel with the back of the camera. This is called the plane of focus. Anything intersecting that plane will be in focus.



A range of standard f-stop numbers, each letting in half or double the amount of light. Your lens has a subset of these same numbers.

F-Stop as Fraction or Ratio

An f-stop of f4 (f/4 or 1:4) means that the diameter of the aperture is 1/4 the focal length of the lens. But there are exceptions this, and the practical implications of this relationship to a photographer are nil.

Nonsense Numbers

F-stops are usually referred to only by their standard numbers (like f8 and f11). These are also the numbers on some lenses. If you want to refer to an aperture between these numbers, you would say something like f11 plus a third-stop.

Digital read-outs are not very good at saying f11 plus a third stop, but are good at saying f10 instead. Although this is the correct number, it is not on the standard stop scale, so for the photographer who is concerned with half and twice the amount of light, f10 doesn't say much.

As stated before, the only thing that matters with focus is distance from the camera. So, if your auto-focus lands upon something that is ten feet from the camera, it sets the focus to ten feet—anything that is ten feet away from the camera will be in focus at this setting.

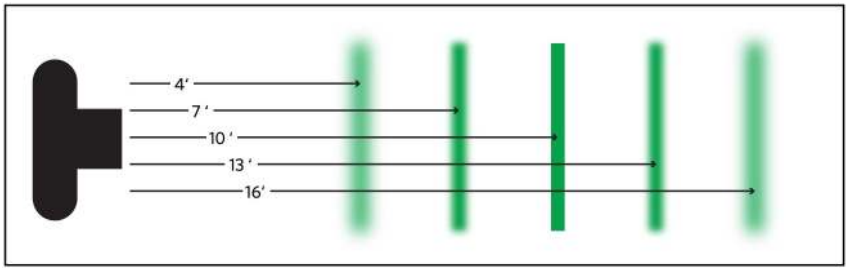
This is all assuming your lens is opened up to the largest aperture. Things change when we stop down to a smaller aperture.

Focus

Focus distances are not from the lens, but from the sensor. This is only a practical consideration when taking very close-up images.



The steel instrument on the left, the copper pipe and parts of the nylon rope all intersect with the plane of focus. In this case that plane of focus includes everything about eight inches from the camera.



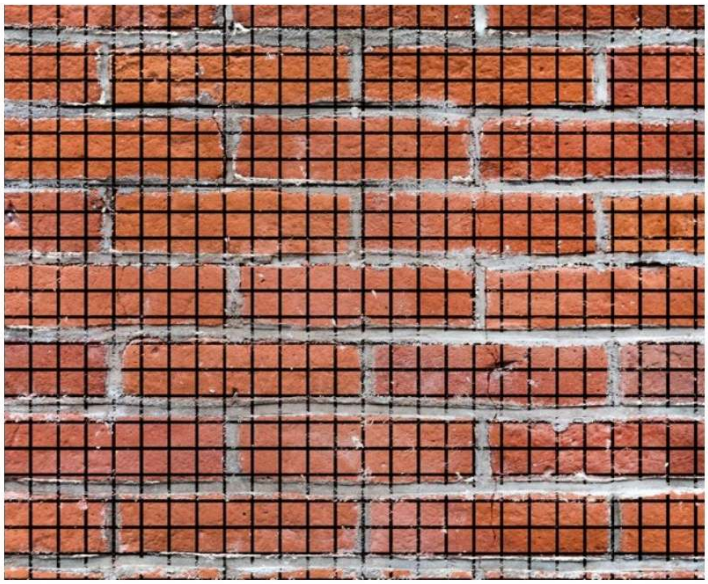
Here the plane of focus is represented in two dimensions by the sharp green line. At ten feet, anything nearer or farther away will be out of focus.
Objects farther away from the plane of focus will be blurrier.

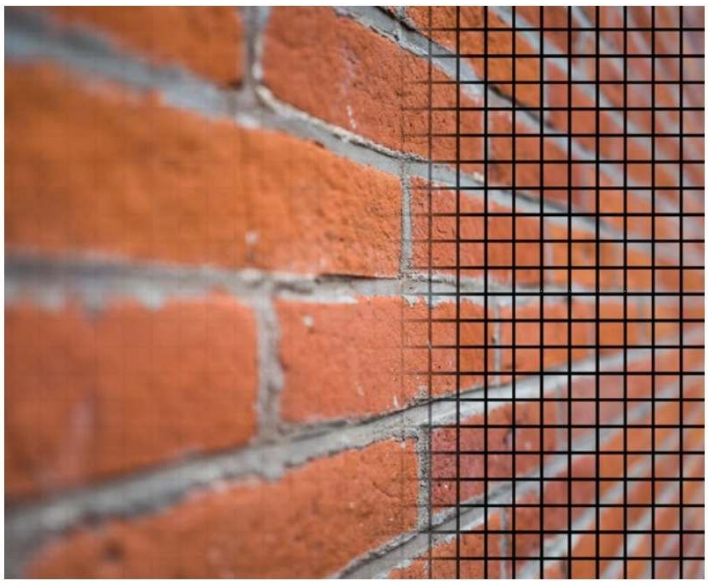
Tilting Lenses

Some special-use lenses and controls for large cameras (image below) allow tilting the plane of focus by tilting the lens.
This allows getting both objects that are close to the camera and those far away in focus at the same time as long as they lie on the same plane (like the side of a building or the ground).
Since these lenses also shift off-axis to control perspective, they are called tilt and shift lenses.



You will probably never need one of these lenses, but it is interesting to know that the plane of focus can be changed.





PLANE OF FOCUS

Here the grid represents the plane of focus. This plane always stays parallel to the back of your camera. Both of the photographs are shot at the same focus and aperture.

TOP The brick wall is parallel with the camera back and therefore the plane of focus, so everything is in focus.

BOTTOM The brick wall is no longer parallel to the back of the camera, so only where that plane intersects is the wall in focus. On the left the focus is past the wall, and on the right it is before the wall.

Depth of Field

As you stop down your camera to a smaller aperture, the plane of focus effectively becomes thicker. More in front and behind the set focus point will also be in focus—lie within that plane of focus, which now has thickness. This thickness (depth) is called depth of field. Less depth of field means that the plane is thinner (therefore has less in focus) and more depth of field means the plane is thicker and has more is in focus. Studying the illustrations on the right and on the next page will help you understand this.

Depth of Field Preview

With most cameras you cannot see the changing depth of field as you change your f-stop. The reason for this is that aperture also controls the amount of light. If DSLR viewfinders actually showed the change in aperture, your viewing would get darker. With electronic viewing systems (DSLR back screen or mirrorless cameras) automatic focus might be less precise.

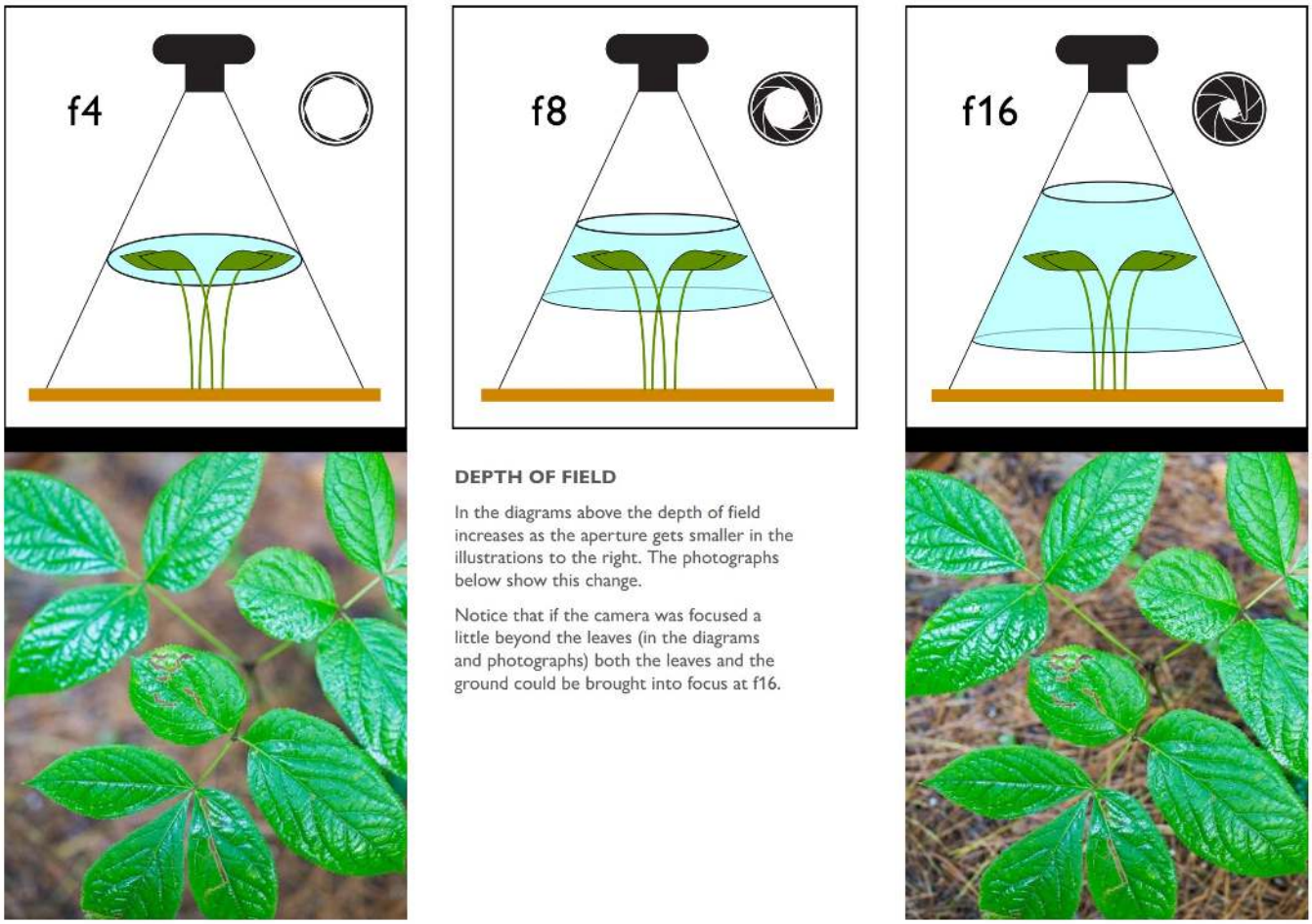
Instead, many cameras only activate the set f-stop when you actually take the photograph: The fully open aperture stops down to your set aperture (f-stop) a fraction of a second before the photograph is taken, then opens back up to the maximum size a fraction of a second after the photograph is taken.





LEFT The plane of focus intersects the tomato stem in several places in this image. Imagine the plane of focus as a sheet of glass parallel to the camera.

RIGHT With the lens at a smaller aperture, that sheet of glass becomes thicker, and now all parts of the tomato stem are in focus.



DEPTH OF FIELD

In the diagrams above the depth of field increases as the aperture gets smaller in the illustrations to the right. The photographs below show this change.

Notice that if the camera was focused a little beyond the leaves (in the diagrams and photographs) both the leaves and the ground could be brought into focus at f16.

Nonetheless, many cameras do have a provision for seeing a depth of field preview before you take the photograph. This is very useful, although it is difficult to see the exact amount in focus on the camera's small viewing screen.

If a depth of field preview can be shown, the method cameras use for activating it varies greatly with the camera model. With DSLRs, it is even different if you are using the viewfinder or if you are using the back screen. Refer to depth of field preview in your camera manual.

In short, if you don't see the amount in focus changing as you change your f-stop, the camera is not previewing your depth of field.

Choosing the Aperture

Changing your aperture and the resulting depth of field is easy. With your camera set to program mode and camera's display active, you just turn the biggest, most immediate wheel (or rocker button) you can find. This will change the f-stop (aperture), which is usually the second number in the display.





LEFT Maddie Fletcher
BELOW Emily McCalla
A common way to isolate subjects from a background is to use a large aperture with its shallow depth of field.





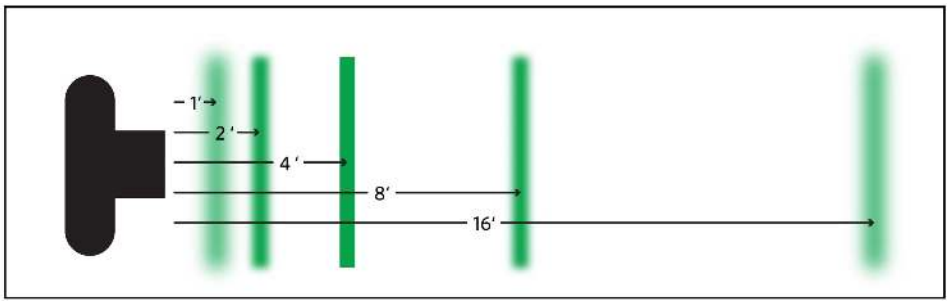


Many times a easier way of changing your aperture (and hence your depth of field) is by setting your main dial to the A or Av (Aperture or Aperture Value) setting. This will allow you to set your aperture directly and not have to reset it with each photograph you take. You might even find that it is advantageous to leave your camera on A or Av as you take photographs. Many photographers prefer this setting over the program (P) mode since it is easier to be more intentionally setting the f-stop (changing the aperture).

Distance

While thinking about depth of field, it is helpful to know that distances in photography are geometric. In other words, doubling the distance of 2 feet is 4 feet, and doubling it again is 8 feet. Practically, this means that if you want your depth of field to cover two objects, don't focus half-way between them, but instead about a third of the way between them (see illustration at the top of this page). This is a good thing to know when you want to maximize your depth of field.

Also important is the fact that the closer the camera is to a subject (the closer it is focused), the less depth of field there is. Even at small apertures, it is impossible get a lot of depth of field when taking close-up photographs.



The geometric nature of depth of field, where the distance from 2 feet to 4 feet is the same as the distance from 4 feet to 8 feet (the first time this illustration showed up it wasn't quite accurate).
If you spend some time pondering this, it might occur to you that there is more depth of field at greater distances and less at close distances.
If it doesn't occur to you, just trust that it is true.



Depth of field decreases at closer distances. The bug-eyed bug is very close. No matter what f-stop you use, getting a lot of depth of field in this situation is impossible.

As distance increases, so does depth of field. With many lenses, any two objects that are over about 20 feet away will both be in focus at any aperture, no matter how far apart they are. As mentioned before, these distances both lie at infinity, a distance that

changes with different focal lengths or different zoom settings.

Focal Length & Sensor Size

How focal length influences depth of field was discussed in the Focal Length chapter. A wide angle lens (or zoom setting) has more depth of field at any given aperture, and a telephoto lens has less.

However, there was a point that was glossed over in that chapter. Although a lens' field of view and perspective is dependent on the full-frame equivalent focal length, the amount of depth of field inherent in a lens is actually in strict relation to the actual focal length.

So, an 8mm lens will always have the same depth of field at a given aperture. It doesn't matter if that lens is used as a very wide angle lens on a large sensor camera or a normal lens on a cellphone camera.

This is why it is difficult to get the background out of focus with cellphone cameras. Smaller sensor cameras always have more depth of field because they use shorter actual focal length lenses.

Shutter Speed

The camera will change the amount of time the sensor is exposed (shutter speed) relative to the aperture you have set.

In other words, when you stop down to a smaller aperture you are not only increasing your depth of field, but also decreasing the amount of light available to the sensor. The camera has to compensate for that decrease somehow, so it opens the shutter for a longer amount of time.

You can see how this works by changing your f-stop as you point your camera at a scene with the viewfinder numbers activated. Not only will the aperture number change, but so will the shutter speed.

Because of this shutter speed change, the amount of light available also effects depth of field. To shoot a scene stopped down to a small aperture like f22, you either need a lot of light (like outdoors) or a tripod, since in low light situations the shutter speed gets too long to not show blur from the motion of the subject or the motion inherent in holding the camera.



Prime lenses often have a depth of field scale on the focus setting. This shows what distances will be in focus at any given f-stop. In this example, at f16 everything from about 2/3 meter (21/2 feet) to infinity will be in focus.
Unfortunately, the mechanics of zoom lenses preclude having these scales.

The Sharpest F-Stop (Part 1)

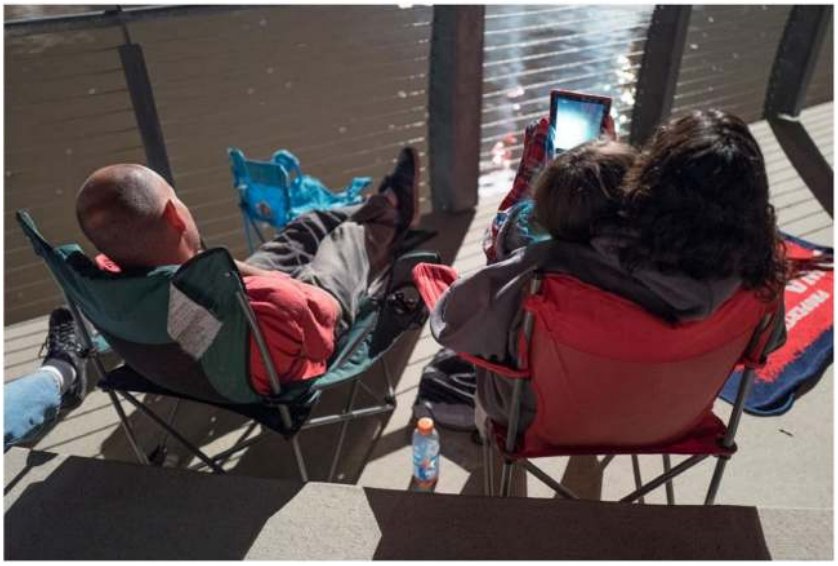
When a lens is used at its largest aperture, sharpness is actually not equal across the field of view, even if the subject is all in the plain of focus. Most commonly the sharpness decreases towards the edges of the frame. Changing to a smaller aperture will minimize this lens fault.

Fast Lenses

Your zoom lens may have a maximum aperture around f4, which is fairly typical of zoom lenses (this may change with the focal length the lens is set to). Lenses which are able to open their apertures wider are generally more expensive since a wider opening means a greater diameter of glass (among other things, such as more expensive glass elements).

The Sharpest F-Stop (Part 2)

While there is more depth of field at smaller f-stops, the sharpness of an image actually decreases after the aperture gets past a certain point. In other words, as you stop down to smaller apertures, any lens starts to take on the characteristics of a pin-hole lens.
Practically this is of little concern, as most lenses will only stop down to the smallest opening where the image appears sharp. But if you are trying to make the sharpest photograph possible (perhaps to print very big), it is a concern.
The sharpest f-stop differs with each lens, but with most lenses it is about two stops short of the smallest aperture. You can make careful tests to see which f-stop is sharpest for your lens. This may also change with different zoom settings



The light source for this photograph was a firework, and the aperture was f1.7. Fast lenses allow you to shoot photographs with little light.
What I was interested in here was the child watching fireworks through a tablet camera. But it is a confused image which shows almost nothing of my intent.

No zoom lens allows very wide apertures. For that, one needs a prime lens. Introduced in the Focal Length chapter, these lenses only have one focal length. They can be had in a variety of focal lengths, with the widest apertures available near the normal (50mm) focal lengths.

With much wider apertures at less cost than zoom lenses, these fast lenses are great for low light situations since they have the ability to open up to apertures as wide as f1.4 (3 stops more light than f4). Some have even wider apertures.

The other advantage of these lenses is the ability to have a narrow depth of field so that areas in an image can be rendered very out of focus.
Portrait lenses (slightly telephoto) have wide apertures to allow the photographer to easily soften the focus of the background. Most lens manufacturers make fast versions of (approximately) 80mm equivalent lenses for this reason.

Fast lenses can get very expensive very quickly, and the ability to open up one stop more light in either a zoom or prime lens can equate to a thousand dollars or more. They are also heavier than other lenses (it takes more glass to let in more light). And, if you

don’t need or want that extra stop of light or less depth of field they are also a waste of money, as they are no sharper or better than the slower version of the same focal length or zoom range.

Confusion

Things out of focus actually form circles, which are called circles of confusion. Normally these circles cannot be seen because they overlap unevenly many times (in the image below, see cars at lower left or shoulders of Knute). When light is from smaller areas, like the light coming through the trees in this image, you can easily see the effect of circles of confusion (which take the shape of your aperture).

Different lens designs render blur differently, and some are highly regarded for the quality of their blur. Blur is also called bokeh, which is the Japanese term for... blur.

That is such a fancy word that it is even a name for a (2017) movie.



Lens Speed

The maximum aperture of a lens is referred to as the speed of the lens. This is probably because lenses that have wide maximum apertures allow you to take photographs at faster shutter speeds. Hence, a fast lens.

Slow lenses (that only open to f5.6 or f4) demand slower shutter speeds, at least in low light.

Now Go Shoot

Changing your aperture, and hence your depth of field, is as easy as turning a dial with your camera set on P or A (or Av). Try it using each mode.

Shoot in different situations with subjects at different distances. How much depth of field do you get with far away subjects compared to close subjects? How much difference is there with your lens set to telephoto compared to wide angle?

As you take photographs try to imagine that plane of focus. Use a wide aperture and telephoto setting (for very little depth of field) to easily see what things are in focus other than what you focused on. Try a small aperture with wide angle setting to see how much you can get in focus from the foreground to the background.

See if you can get a lot of depth of field in darker situations without blurring the image. See if you can get very little depth of field in bright sunlight without the image being overexposed. Different cameras will produce different results.

Look at the quality of the blur when things are out of focus. Is it pleasant or distracting? How much blur is there at different distances?

Pay attention to your aperture number as you shoot. How much do changes in the numbers influence your depth of field? You don’t need to remember the exact f-stop numbers, since you can choose something around f4 or a lower number for little depth of field

(or more light) and a higher number like f16 or above if you would like a lot of depth of field.

If your camera has a depth of field preview, try using it. Compare the depth of field it shows in the viewfinder with the image enlarged on the computer screen. Could you see exactly what would be in focus on the viewing screen?

Melanie Oeltjenbruns, f4.5 (top) and f16



EXPERIMENT

With your camera set on A (or Av), shoot one scene with at least two different f-stops. Make these f-stops as far apart as possible. Make all other things (like focus and framing) exactly the same. What you are trying to demonstrate is the change in depth of field.

Outdoors you may not be able to get a change in aperture (and corresponding depth of field), so it may be more practical to do this indoors with the camera on a support.

Make sure your scene is suitable to show depth of field. This is not the same as the focus experiment: In this one your point of focus should stay the same with all your photographs. You may want to do several sets of these and make sure you can see depth of field working. You should not have changes in overall exposure!

What you should see is the plane of focus getting thicker (your depth of field increasing) with every decrease in aperture size.

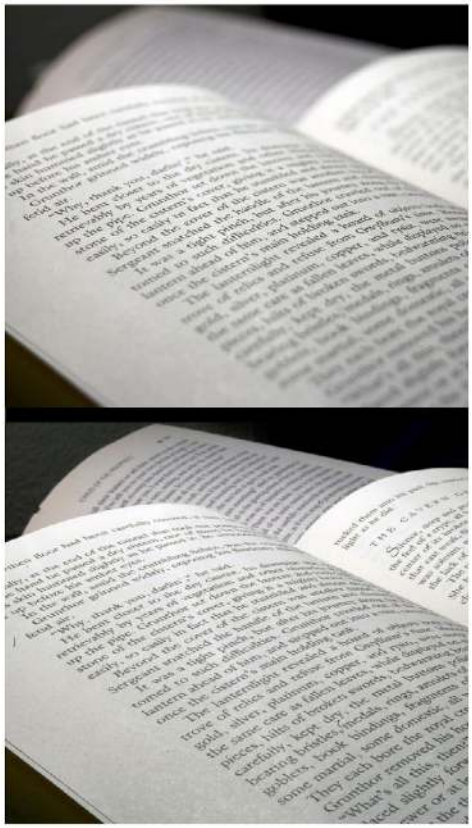
Some Depth of Field Hints

Make sure your foreground is very close, especially if the sensor in your camera is small.

Do not change your focus point between images—be it on the foreground, background, or in between.

Your overall exposure (lightness) should be the same in the pair of photographs. If it is not, redo it.

Your camera may indicate at a given aperture (with a blinking or red number) it cannot maintain the correct exposure—try a different lighting situation if this is the case.



Krystal Larson f5.6 top, f32 bottom

Depth of Field Questions

What is the number assigned to the aperture size called?

What f-stop will let the most light through the lens? The least light?

If your f-stop was f8, what f-stop would let in half the amount of light? Twice the amount? At other f-stops?

apertures in stops: f2.8 - f4 - f5.6 - f8 - f11 - f16

What does the depth of field refer to?

Aperture controls the amount of light and what?

What f-stop would give you the most depth of field? The least depth of field?

What mode dial setting allows you to set your f-stop directly?

How far should you focus past the foreground to possibly get the background also in focus?

Can you get one object at infinity out of focus while getting a second object also at infinity in focus?

Which has more depth of field at a given f-stop—a 20mm lens or a 80mm lens?

With closer objects is there more or less depth of field?

In general, do cameras with large sensors or small sensors give more depth of field?

How does the camera compensate for less light with a smaller aperture?

A lens with a large maximum aperture is called what? What is an advantage of a fast lens? A disadvantage?



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7.1: 7PH PHOTOGRAPHS LIE

In the 1850s Britain was engaged in an ugly war in Crimea. News reports criticized the British involvement, with descriptions of failures and disease. To counteract these reports, a photographer, Roger Fenton, was encouraged by people in the government to bring back a rosier view of the conflict. Fenton, although encountering severe hardships in Crimea, did that.

Photographs lie. Not only Photoshopped images, but every photograph—even before Robert Fenton was sent to Crimea. Photographs lie by exclusion. The frame omits important elements and time is distorted into a slice. They lie because the camera does not see how we see—our eyes have a very small sharp area (that is why your eyes are moving as you read this) with a very wide indistinct frame. Depth in photographs is compressed into two dimensions, and important details, such as sound, are omitted. To make matters worse, humans seem to be inclined to take vision, and therefore images, as the truth. To say I see means I understand.

Illustrated here are two photographs of Lake Louise in Banff National Park. One shows a fairly pristine and majestic landscape, while the other shows a very crowded tourist spot. Which is the truth? In a way, they both are, and the lake can even be experienced both ways. Ask someone how they liked going to Lake Louise and one person may say that it was a madhouse with difficult parking, while another may say it was the most beautiful lake they have ever seen.





When photographing you are not presenting The Truth, but an impression of it. This is also true with photojournalists. They approach the world knowing that there are many truths to be told. Photojournalists' responsibility is to present the most objective truth they can, although this comes with many caveats. If they photograph a hurricane as most people experience it, they will have

photographs of people sitting around in a room waiting for the wind to die down. And that photograph will win no Pulitzers, nor in most circumstances will it even get published.

Responsible journalism is where the photographer presents the public with a view of a situation which is biased (because a human is creating it), but is also true to what is happening while still capturing our attention. One of the most respected photojournalists is **Eugene Smith**, who is able to show incredible empathy for his subjects. **Robert Capa** is most known for his fearless depictions of war. **Weegee** presents a darker side of crime with the decidedly unromantic photographs he took while following police on their beats. **David Seymour** (Chim) helped form Magnum Photos, which is the most well-known group of photojournalists. Another founding member of Magnum is **Henri Cartier-Bresson**, whose book title The Decisive Moment sums up an important strength in his images. **Burk Uzzle's** photographs are full of humor and unexpected interactions. **James Nachtway** and **Paul Hansen** take unflinching photographs to try to change a reality filled with conflict and injustice.

Chutzpah

Some might say the inclusion of the author's own photographs and stories next to history's greatest photographers is cheeky at best. That he is doing it perhaps to be blessed by association, or in hopes that proximity will make some of that talent wear off.

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7.2: 7CR LENS CORRECTIONS

Lens Profile

All lenses have faults which Camera Raw can correct by simply telling the application which lens you are using.



The first image below has parallel lines that bow out. This type of distortion, called barrel distortion, is common with wide angle lenses. The second image has this distortion corrected automatically by Camera Raw.

Go to the Optics panel to bring up the Lens Corrections panel, then choose Use Profile Corrections. With newer common cameras, Camera Raw will recognize
the camera/lens combination automatically.

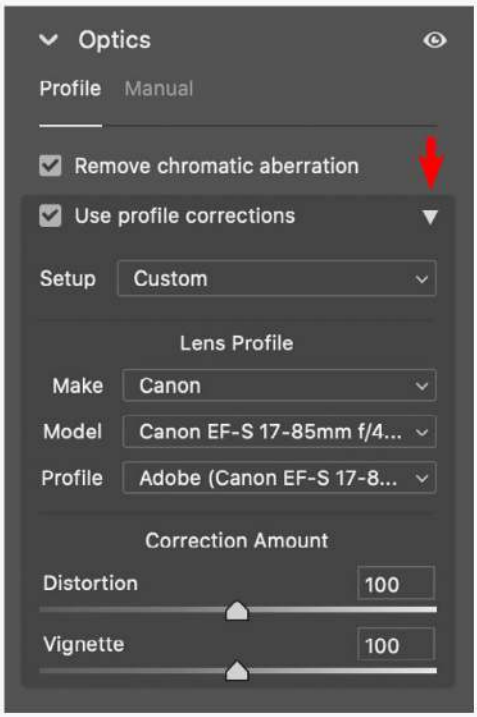
Careful inspection of the images at left will reveal another difference. The first image has darker corners. This vignetting is mostly caused by the fact that the center of the sensor is closer to the lens, and therefore gets more light. Profile Corrections also corrects for this automatically.

If the corrections for distortion and vignetting are not quite right for your image, you can always further adjust them using the sliders at the bottom of the Lens Correction panel.

If your lens is not recognized by Camera Raw, there are two things you can do. First, look for a camera/lens combination in the drop-down menus that appear when you click the disclosure triangle (arrow). Select the lens that you have or one that may be close to what you have.

If there is no camera/lens combination close to what you have, you can manually adjust vignetting and distortion using the sliders under the Manual Tab near the top of the Optics panel. This tab also has color corrections which will be covered on the next page.

These lens corrections may not be necessary, and unless you take photographs of things like buildings, you may never need them. Applying them unnecessarily will not visibly degrade your image, so you can use them whenever you have doubts, although some vignetting can sometime be beneficial to an image.



Near the corners of an image with high contrast there can be bands of color called chromatic aberration. It is often seen as a purple fringe around objects as you can see in the first image on the right. It may also show up as other colors, and many times one side of an object will show one color, and the other side a contrasting color.



This is easily corrected in the Lens Corrections panel by activating Remove chromatic aberration (middle photograph on the right).

The Manual tab for the Lens Corrections panel lets you further remove the chromatic aberration (click on the disclosure triangle to get to these controls). This is how the remaining purple fringing was removed in the bottom image.

Generally, when manually correcting aberration, you can just slide the Purple or Green Amount. If you do need to tweak the Hue adjustments it will be obvious which range of colors to specify.

Be careful that you don't also remove any important details that may be colored similarly to the fringe color.

Also notice that the Distortion and Vignetting controls on the Manual tab have a much greater range of adjustment than the ones on the Profile tab.



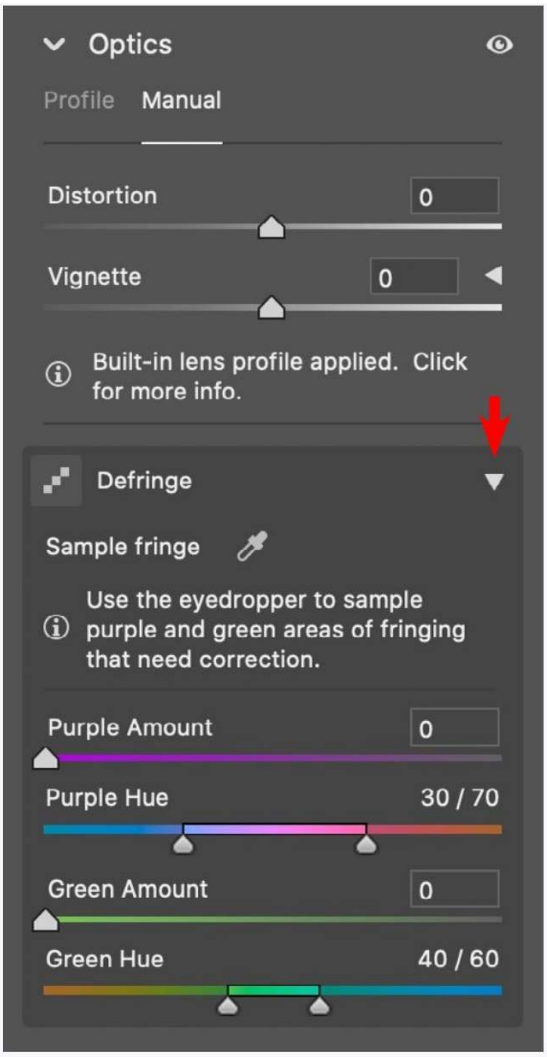
Original Image (detail)



Lens profile with Remove Chromatic Aberration



Lens profile with Defringe adjustment



Imagine you buy a hex wrench at the hardware store. You may never need it. But then you have to take out a screw that has a funny-looking slot on it that a regular screwdriver won't fit into. Suddenly you are very glad you bought it.

These techniques are a lot like hex wrenches. Some people need them often, some people will never need them. And some will only need them occasionally.

So, here I am taking you down the hex key aisle just in case you need it. These techniques don't take practice, just an awareness of how they work and what they are good for.

LENS PROFILE

The first thing I do when importing images is apply profile corrections. It is easy to do, and at least with my cameras it not only straightens curved lines, but also lightens the edges to make the field of tonality even.

I suggest you at least try the profile corrections on a few images to see if it improves them (the strength of the effect depends on the lens used).

Try the manual corrections instead of or in addition to the profile corrections. The profile correction is not always perfect, and tweaking it with the manual corrections may be necessary.

If you take photographs of people you may never need these corrections. If you take architectural photographs you may always need them.

CHROMATIC ABERRATION

How much you need to correct for chromatic aberration really depends on how you take photographs. Like the lens profile corrections, you may never need this. At least try to find an area (near edges at 100% magnification) that needs correction in an image and apply the correction. That way you will remember it is there if you find you need it later.

CAN YOU...

Notice any curvature or vignetting inherent in your lens and correct for it by applying a lens profile?

Manually correct for curvature and vignetting both in the profile and manual panels?

Notice any chromatic aberration inherent in your lens and correct for it?

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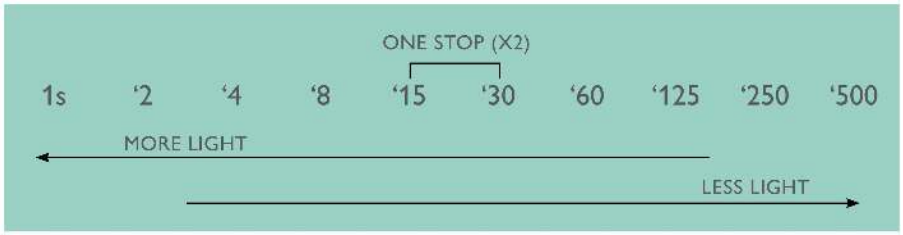
8: Motion

This chapter wraps up the main controls for exposure. Controlling motion with shutter speed is easily understood, but there are a few things that need some explanation.

A shutter is a tiny sliding door which opens and allows light to the sensor for a specific amount of time when you push the shutter button all the way down. This time is usually in fractions of a second.

As with apertures, different cameras have different ranges of shutter speeds, but almost all range from one second to a one-thousandth of a second. Each doubling of the shutter speed number lets in twice as much light, so 1/30 of a second lets in twice as much light as 1/60 of a second. That makes sense because the time is doubling. Here again is the concept of a stop: halving or doubling the amount of light. So, 1/125 of a second lets in one stop less light than 1/60 of a second.

Shutter speeds are noted in shorthand on the camera and in literature. 1/125 second is written as ‘125, ‘125s, or as 1/125s. Sometimes only the denominator of the fraction is used, like 125. If the exposure is in full seconds, it will be noted as 4.0s or 4s, meaning 4 seconds. You may notice that some standard shutter speeds do not exactly double (i.e. ‘60–’125), but they are close enough to essentially double. As with f-stops, your camera has fairly undecipherable numbers in between the standard shutter speeds. Do not pay too much attention to these. Instead, understand (you don’t have to memorize) the speeds listed in the illustration above.



A range of standard shutter speeds, each a stop apart. Your camera probably continues beyond this scale.
Below 1/4 second (‘4) most cameras report the shutter speed not in fractions, but in tenths of a second, so 1/2s becomes 0.5 seconds.

Noise Reduction

When you use an exposure longer than a second you will notice that (on the default settings) most cameras will have a lag time equal to the exposure time before you can use your camera again or review the image.
The camera is actually taking a second exposure of nothing during this time. It takes the sensor defects from that second image and subtracts them from the image.

Long Shutter Speeds

There is another shutter speed setting on most cameras, which is B. This stands for Bulb, and at this setting the shutter is held open for as long as your finger is pressing down the shutter button. With a remote release connected to your camera you can lock the shutter open for as long as you want. If you don't have a remote release, you can tape something over the button to hold it down.



This photograph was taken well past dark at an exposure time of 30 seconds. A long exposure (with a tripod!) or a very high ISO (with the accompanying noise) would be the only two options for getting an exposure in this dark environment, even with a fast lens.
Notice that the tree is blurry as it was moving with the wind.

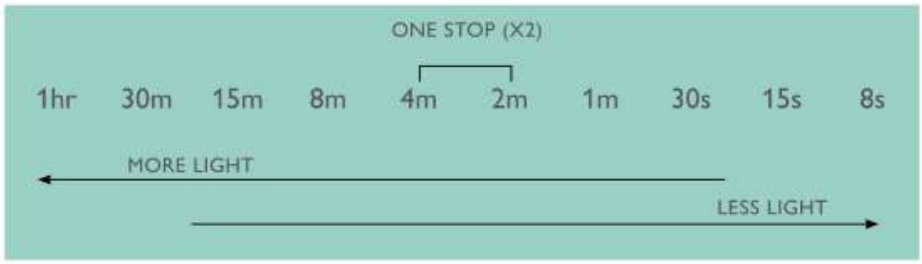
Shutter Roll

At speeds higher than 1/125s the shutter does not actually open all the way. Instead, a slit moves across the sensor area, first exposing the top or bottom then moving its way across the sensor.
With very rapid camera or subject movements, this causes distortion in the image, and can be seen as tilted, curved or disjointed objects. This is shutter roll.
Instead of a shutter, some cameras (most notably cellphone cameras) activate the sensor for recording when you take the picture. Sensors don't take in the entire image in one go, but instead start recording at the top or bottom, then record in strips, just like a physical shutter. So, this shutter roll is even present with these systems.
Chances are good that you will never see this effect, since the movement has to be very rapid to show up and irregular shaped objects (such as a person running) do not readily show the distortion.



One would hope that shutter roll is causing the propeller to appear to come apart.

This is the way you can get exposures that are very long, such as those needed for photographing at night. But beware, remember that doubling or halving shutter speeds adds or subtracts a stop of light. So, if you have an exposure that is four hours long, one stop more light would be a full eight hours!



A range of slow shutter speeds in minutes (m) and seconds (s). Most cameras have slow speeds that extend to 30 seconds. For longer exposures use the 'B' setting.

Short Shutter Speeds

Very short shutter speeds, such as 1/1000s, are very good for stopping motion with very little or no motion blur in the image, even with fast-moving subjects. However, they are not practical unless you have a lot of light to begin with, such as on a sunny day. In lower light you can use shorter shutter speeds if you have a higher ISO set—if your quality needs can accommodate the increase in noise.

Bulb?

Why is it called bulb? It could be that early flashes required you to hold down the shutter, but this was in the age of flash powder, not after flash-bulbs came out.

It could also be that remote releases were pneumatic, so squeezing a bulb pushed air through a long tube which was connected to the shutter. Most likely the B in Bulb actually came from the German word Beliebig zeit which means any time.

Older cameras often have a 'T' setting, which opens the shutter with one push and closes it with a second push or film wind. It seems pretty clear that the T stands for Time.

Motion Blur

When your image has something in the frame that is blurry from movement it is called motion blur. Don't confuse this type of blur with the blur of something out of focus.



Flowers blurred by rotating the camera during a one second exposure. Motion blur can sometimes be confused with the blur from being out of focus, but not with this example.

Motion blur can either be because of movement of the camera or of the subject. In either case, the image projected onto the sensor moves during the time the shutter is open.

Camera Movement

The degree of motion blur you have is dependent on several factors. Camera movement that causes blurry images is also called camera shake, since the shakiness of hands holding the camera is the most likely cause. This can be influenced by how much coffee you have had, your natural shakiness, and how you hold the camera (covered in the Basic Camera chapter).

The focal length of your lens can also influence the blur from camera movement. A telephoto lens will not only enlarge the subject but also enlarge any small movements of the camera.

The lowest shutter speed you should attempt without a camera support is the shutter speed that matches the focal length setting of your lens. So, with your lens set to 50mm you are generally fairly safe with 1/60s. With a 100mm setting you are fairly safe with 1/125s.

While the relationships of these numbers holds true, different people will get different mileage (and have different expectations), so the best way to find out the slowest speed you can hand hold your camera is to experiment and be aware.



Since the paintings are not moving, it is obvious that the blur in this image is from camera movement.



In this image you can also see the direction of the movement of the camera from the blur direction.
Notice how the size of your image can determine how much any blur (motion or focus blur) is noticeable. It is always a good idea to check your camera's review image enlarged as much as possible (see camera instructions) to see if there is blur in an image.

As discussed before, many cameras also have image stabilization (vibration reduction or whatever they call it). This mechanism cancels out camera movement to some extent. Many manufacturers claim that this allows you to take hand held photographs at a two or three stop slower speed while still maintaining camera stability. These claims are fairly reliable, and often with a wide angle lens you can take photographs as slow as 1/8s and avoid blur from camera movement.

Subject Movement

Even the best image stabilization mechanism on a camera will not hold the subject still, however. When there is blur in the image that comes from the subject moving, it is called subject movement. Of course.

What really matters with subject movement is the relative motion of the subject, or the amount the image moves on the sensor during the exposure. So, if you are in a car traveling at seventy miles an hour, and you take a picture of someone else in the car, the actual motion is great (seventy miles per hour), but the relative motion between you and the subject is small. If, however, you are standing on the side of the road and the person in the car goes close by you at seventy miles per hour, the relative motion is great, and a picture of them will have motion blur.

In the first instance, the projection of the person in the car stayed in the same place on the sensor. In the second instance, that image is moving rapidly across the sensor.

The concept of relative motion also holds true for things that are moving towards the camera, which have much less relative motion than things moving across the field of view. Think of that little image on the sensor and what is happening to it during the fraction

of a second it is being exposed. Relative motion is pretty easy to predict, because it is the same motion that you see in the viewfinder.



The desert from a car at highway speed. Nearer things have more relative motion (motion on the sensor), and so are blurred more. Relative motion is why the moon appears to be following you as you drive at night.

Dizzy?

The spot you are at now is spinning at up to 1,000 mph. And it is moving around the sun at 67,000 mph. Be thankful for relative motion.

RELATIVE MOTION



LEFT All these runners are running at approximately the same speed. The runner on the left is both closer to the camera and moving across the field of vision. Since the relative motion is great he is very blurry.
The runner on the far right is farther away and running in line with the field of vision
(away from the camera). Since the relative motion is less, he looks reasonably sharp.
BOTTOM There are varying amounts of motion blur in this image, depending on the amount and direction of the motion of the person. It is sometimes impossible to predict the amount of blur that will be present in an image, so experimenting while shooting is important.



Panning

So far in this discussion motion blur has been treated as something to be avoided, but actually it can be desirable in many situations.

For example, if you are taking a picture of a friend running by you at a fast shutter speed, they can look quite slow or even unnatural if you stop all movement. Instead, you could use a slower shutter speed and blur the background with motion.

The way you do this is to keep the runner fairly motionless in the viewfinder by following them with the camera aim as they run past. When you take the image, the relative motion between them and the sensor is small, since you are following them with your aim, but the relative motion of the background is great. This is called panning with the subject.

There are many other instances where freezing the motion in a photograph can suck all the life out of it. The point is to control the motion.



ABOVE In this example of panning, the camera aim was kept on the woman looking out the window while the shutter was pressed. LEFT The camera was in a boat going past the boat in the image. The camera's aim was kept on the center of the movement (the boat).



Choosing the Shutter Speed

When you chose the aperture while on the P setting, you noticed that your shutter speed also changed to keep the total amount of light constant. When you are changing the shutter speed, you do the exact same thing in P mode—but now you are paying attention to the shutter speed instead of the aperture.

As with aperture, there is also a setting that allows you to set a shutter speed so that you do not have to reset it after each picture. On the main dial this is either labeled S or TV (Shutter speed or Time Value). With this mode selected, set the shutter speed where you want it and the camera will automatically set the aperture to compensate for the amount of light available.





When you set the shutter speed like this, the camera has a limited range of apertures from which to select. If it cannot find a suitable aperture the exposure setting will blink (or somehow signal you are out of the aperture range) and your photographs will be too dark or too light.



Hannah Kilburg. If things are moving in a scene, the shutter speed becomes very important.

Filters

Dark filters placed over the lens are called neutral density filters, and their strength is measured in stops. These allow you to use slower shutter speeds in bright light. Polarizing filters also limit light. More importantly, they also eliminate some reflections on things like glass and darken parts of a blue sky.

Different kinds of filters allow you to do such things as soften the focus, change the color and tone of one area (like the sky), get closer images, or turn highlights into star-shapes. There are many photography accessories that can separate you from your money. B & H Photo is helpful in this regard.

For example, if you try to take photographs on a sunny day at 1/8s, your aperture might need to stop down to f128. Common lenses do not stop down that far, so your camera would use the smallest aperture, but it can’t go far enough. Hence, the image will be overexposed—unless your camera is set to override your selected shutter speed in this situation.

Speed & Aperture Together

Program mode is a very versatile setting because it allows for easy control of both the shutter speed and aperture. Turning the main wheel can give you more or less depth of field or more or less motion blur. And yes, one always affects the other.

Sometimes using A (Av) or S (Tv) will be more convenient than the P mode. Each of these three modes will take the exact same picture, but each will allow you to control the shutter speed and f-stop differently. Experiment with this. Personally, I find that with

one camera I frequently use I almost always use the P mode, and on another camera I use the A (Av) mode. Whatever setting works best for you is the best setting!



Shutter Speeds of ‘200, ‘4, 1s. Notice that although the f-stops must have changed to compensate for exposure, depth of field is not an issue. Even at a large aperture everything would be in focus since all the elements in the scene lie at infinity.

How Sharp?

In general photography use, sharpness is a subjective term. The degree of sharpness is not only determined by focus, shutter speed and f-stop, but also on such things as the type of subject; the size of image and its viewing environment; and the viewer’s expectations (and eyesight!).

ISO and Exposure

ISO, just as the amount of light available, influences the shutter speed and aperture you use. Higher ISOs will allow you to use shorter shutter speeds and/or smaller apertures.

Conversely, lower ISOs will allow you to use longer shutters speeds and/or larger apertures.

Which bring us back to the main exposure controls introduced in the Basic Camera chapter—shutter speed, aperture, and ISO. Adjusting all of these together is key to controlling the interpretation of a scene, and that is the subject of the next chapter.

Now Go Shoot

Changing your shutter speed, and hence the amount of possible blur is as easy as turning a dial with your camera set on P or S (or Tv). Try the two modes in different situations with subjects moving at different speeds. In darker situations see how slow you can go before you get camera movement blur.

Try panning with a moving subject. Perhaps use a tripod and take photographs in dark situations with a moving subject.

How slow can your shutter speed be if you have a lot of light? How fast can it be with little light? How does changing your ISO help you get a faster shutter speed with low light? Try intentionally blurring things, even with camera movement.

Motion blur can either liven up an image or it can kill it.

EXPERIMENT

This is almost the same as what you did with the aperture experiment, only now you will be using the T or Tv setting on the mode dial to control movement blur.

With two or more images, demonstrate using different shutter speeds to vary the motion blur of the subject. Use a constant motion source. Someone jumping is not constant—they speed up and slow down during the jump.

Do this experiment with the camera on a steady support. With a lot of light you will not be able to get a slow shutter speed, so it may be best to do it indoors or at least not in direct sunlight.

Your set(s) of images should have only one variable—shutter speed (although aperture will necessarily change). Keep all other things the same. They should also all be the same exposure—if some are lighter than others then something went wrong (make sure

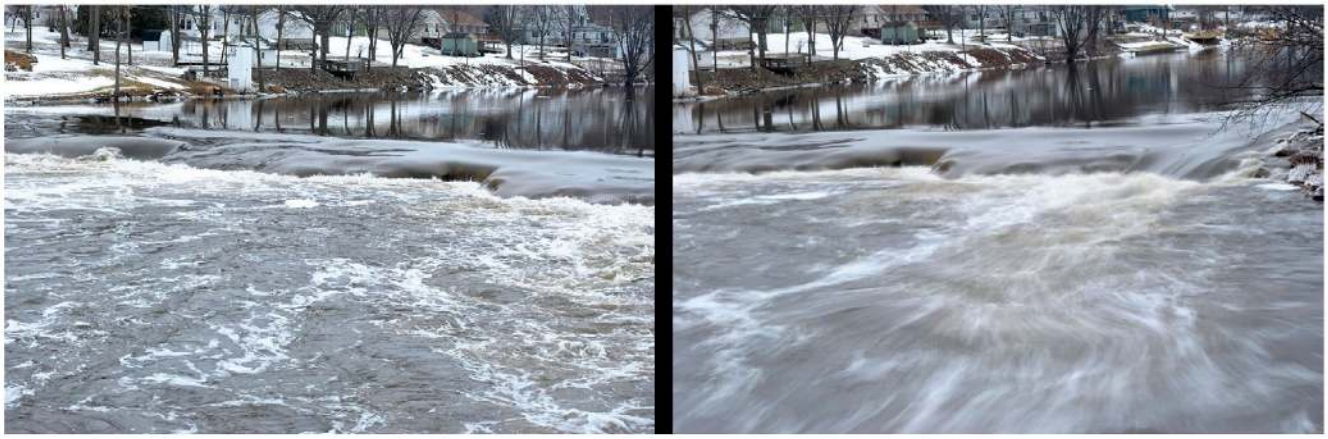
aperture number is not blinking). And do not confuse shutter speed with ISO—completely different things, although ISO will influence shutter speed.



James Blake, 1/2 second (top) and 2 second shutter speed comparison Having the people walk by at the same speed was important for this comparison.



Bailey Meiklejohn, 1/10 second shutter speed and 1 second shutter speed



Jordon Anderson, 1/30 second shutter speed and 1 second shutter speed

Motion Questions

Twice or half the amount of light is referred to as what?

One stop less light than 1/8th of a second is what? One stop more light? At different shutter speeds?
shutter speeds in stops: ‘4 - ‘8 - ’15 - ’30 - ’60 - ‘125 - ‘250

What setting holds the shutter open for as long as the shutter button is held down?

What is the slowest shutter speed you can use to get sharp images with a 50mm lens without a tripod?

What do you need to use a very fast shutter speed such as ‘2000?

Motion blur can come from the subject movement. Where else can it come from?

Absolute motion is not a factor in subject blur. What kind of movement is a factor?

What is it called when you move the camera’s aim to follow a moving subject?

What camera setting on the mode dial would you use if your main concern was to stop motion?

Which setting besides aperture enables you to (indirectly) avoid blur in lower light?



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8.1: 8PH THE IDEA



A while back I went to an art museum to listen to a lecture by a very good (and famous) photographer. The museum curator introduced him to the audience, whom she welcomed as shutterbugs. There was a collective sigh in the audience. It was a demeaning term meant to assert the authority of real media, like painting and sculpture. We will let you shutterbugs into our institution, but be assured we are just letting you into the kids' play area. Here is a bit of history:

In the early 20th Century, artists were experimenting with the idea of having art be not so much about the image, but more about the idea behind the image. Actually, this is a very ancient concept. So Duchamp could have a painting of a tobacco pipe and under it state that it was not a pipe (in brief terms, it is a picture of a pipe). This art based on the idea continued, and starting in the 1960s it became the movement called Conceptual Art.

Photography, which has always been a sort of bastard child of the art world, suddenly found a home with Conceptualism. Photography is a medium particularly suited to expression of the idea in that it can be very banal, which forces the viewer to the idea. Also, it is an underdog medium—the perfect thing to challenge The Art World.

With photography suddenly a valid art form, its status as art was not only limited to Conceptualism, but also things like landscape and abstract photography. Photography busted the art museum door down and called squatting rights. Older photographers were venerated, and prices for photographic prints skyrocketed. Although some museums still treat photography as a craft (another demeaning term in this context), many have accepted it as worthy, on par with traditional media.

So, at least in this view of things, conceptual photography is a crucial part of photographic history. Many artists combine photography (their own and ones taken by others) with other media. A couple of Bruces (**Bruce Connor** and **Bruce Nauman**) and **Richard Prince** have incredible 'illustrations' of their ideas. If you don't think life can be pretty bizarre, don't bother trying to get the humor of **John Baldessari**, **Ed Ruscha**, and **Robert Cumming**.

Carrie Mae Weems explores being black, **Judith Golden** explores a more transcendental experience, and the team of **Bernd and Hilla Becher's** photographs of similar things put near each other are more meaningful than they really should be.

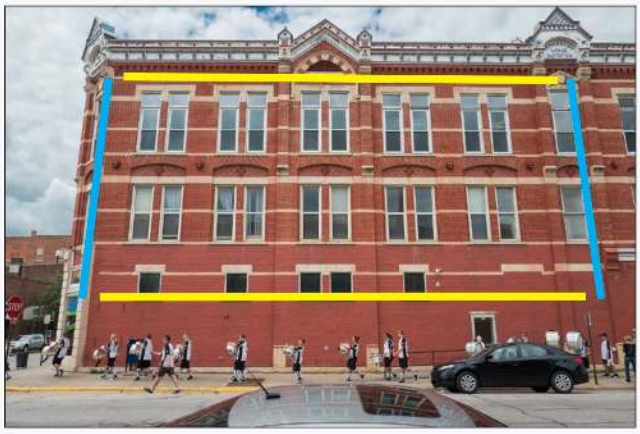
But of course all this categorization with these photographers is essentially just a path to start exploring. Is **John Divola** concerned with the idea or the image? It is both.

Really, all photography could be seen as being about the idea. But these are some of the photographers who do it more obviously.

Artists known for their work in traditional media have also leaned heavily on photography, either by using appropriated images (not their own) or photographs they themselves take. Of course, **Andy Warhol** famously fits in this category, but also **Chuck Close**, **Robert Rauschenberg**, **Robert Heinecken**, and **David Hockney**.

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8.2: 8CR TRANSFORM TOOLS





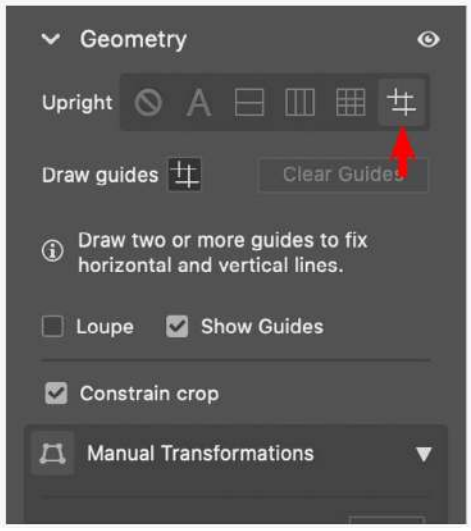
A common cause of parallax comes from pointing the camera up at a building. In the second illustration the parallax is not fully corrected, as in this instance it would make the building look top-heavy.

Sometimes converging parallel lines in photographs are distracting. This convergence is called parallax. The Geometry panel allows this to be corrected.

The first four Upright buttons after the none button let Camera Raw automatically figure out how to do corrections. However, the last button, Guided, is the most powerful.

When you click on it, you can draw either two lines in your image over lines which should be parallel (like the blue lines in illustration), and also a second set of parallel lines which should be parallel (yellow lines in illustration). Camera Raw will correct the distortion based on the lines that you drew.

You can instead correct parallax (among a few other things) manually using the sliders below the tools (by clicking the disclosure triangle).



There are a few more buttons on the right of the interface that you may (or may not) find useful:





Paint over a duck or leaf with Spot Removal. It will replace that area with another (movable) area. It also works on ex-girlfriends if they are small and/or far away. The Heal and the Clone options for this tool each work a little differently, and can be changed after painting.



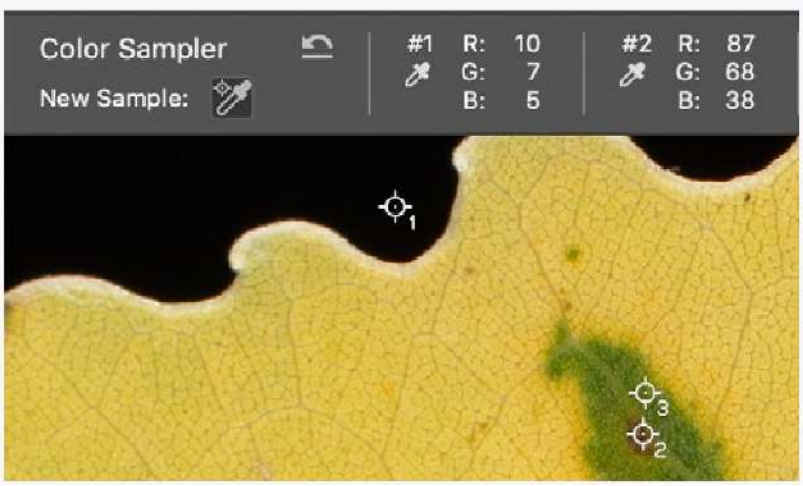
Red Eye Removal does what it says. That red area in eyes is actually an image of the back of they eye which only light coming from near the lens reveals. It
is more apparent in low light since the aperture of the eye (iris) is larger.



The Snapshots Panel allows you to save your images in stages. Just click the page icon on the top of the panel. These snapshots will be available in future editing sessions.

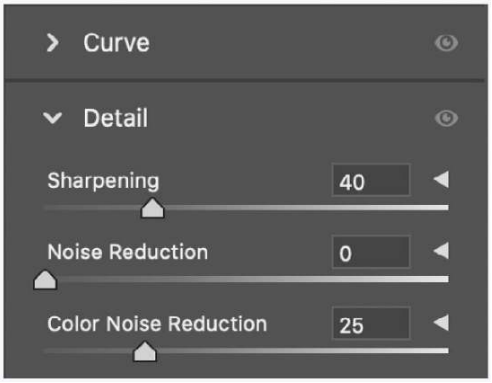


The Presets Panel lets you save sets of adjustments for later use. These are saved with the application, not the image you have open, so they are available with any image you open in the future. There are also many premade presets which you may want to explore.





The Color Sampler (near the bottom of the right side) allows you to get a readout of the colors for each part of the image you click. These numbers change with adjustments, so they are useful if you are familiar with identifying colors and tones with RGB levels 0-255.



Back at the edit panels, Detail can be very useful, but the details of Detail (click on disclosure triangles) are beyond the scope of this book.



Split Toning is intended for correcting image defects in older cameras, JPEG files with the wrong white balance, and possibly for an effect you might want. Images converted to black & white can also be split-toned to give them a duotone look. Just pick a color and saturation for the shadows and highlights. You can also define the dividing point of the colors between shadows and highlights.



The Effects Panel is just a couple of things that just didn't quite make the cut to be in the other panels. Notice the disclosure triangles.



It is best to leave Calibration alone unless you want to get really picky about how Camera Raw interprets color from your camera.

The good news is that (like the last set of instructions) these are tools that you may or may not need, but are easy to learn.

If you want to practice something, go back to image adjustments and local adjustments. Those are the things I am sure you still need to work on. For the tools here, just work through them so that you know what they do in case you do need them.

And keep this book for reference. I doubt that you can sell it for much anyway.

GEOMETRY ADJUSTMENTS

If you don't have a picture of a building, go out and take one. At least take a photograph of something that has straight lines, like the room you are sitting in right now (spooky how I know where you are).

Try the various automatic transform tools. Play with the sliders. Zero out your controls and try the guided tool and draw lines on your image to straighten them to each other.

THE REST

Try each of the rest of the tools. Some may be helpful. For instance, if you often take the lens off your camera I am sure you will use the spot removal tool a lot. That dust just stays there casting its shadow on every image you take.

Your way of working may also benefit from using the snapshots panel. Or it may not.

CAN YOU...

Straighten a crooked image?

Use different techniques to correct for converging lines (parallax)?

Remove blemishes (from a pimple to an old boy/girlfriend) from an image?

Remove the image of the red back of the eye from a flash photograph of a person?

Save your changes to an image using snapshots?Save color samples from an image?

Apply split toning to an image?

Save sets of adjustments to use on other images?

Apply at least a few effects that an image might need?

Leave the camera calibration alone?

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9: Exposure Controls

This chapter rounds out your knowledge and allows you to understand a key relationship in photography so you can really control the your photographs and do some cool things.

There is not much text here, but a lot of illustrations (such as the ones at right). Make sure you understand these as they explain relationships students often have trouble grasping.

Shutter Speed & Aperture

In the previous two chapters shutter speed and aperture were examined. To see how they work together with exposure, just remember three things:

1. Each number change given in this text is one stop (twice or half the amount of light).
2. Higher shutter speed numbers let in less light.
3. Higher f-stop numbers let in less light.

Now look at the diagrams on this page and see if you can understand them with these three facts in mind.

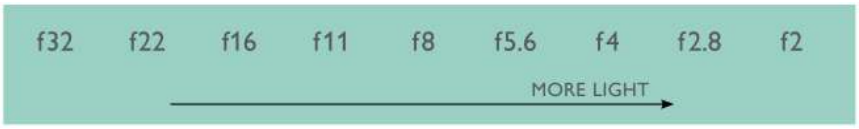
The direction of more light is reversed for this demonstration. Shutter speeds are more light to the left and f-stops are more light to the right. This way the relationships can be shown clearly.

If you really understand this page fully, you might not need to read the next page, although it can't hurt. Be aware that these are simple relationships but they can get confusing rather quickly.

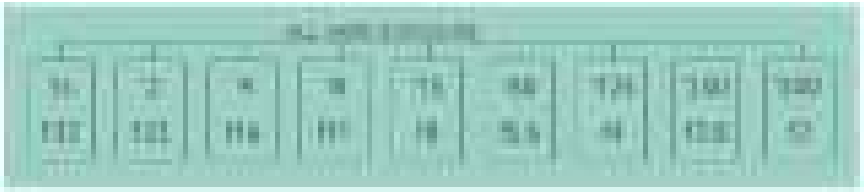
This is a key page that may be worth referring back to as you read this chapter.



Review: A typical shutter speed range. Each of these is one stop apart.



Review: A typical f-stop range. Each of these is one stop apart.



Not Review: Both scales together. From the left to the right each box has a shutter speed which is decreasing the light. But each box box also has an f-stop that is increasing the light, so as far as overall exposure they are canceling each other out. So, the overall exposure in all the boxes is the same.

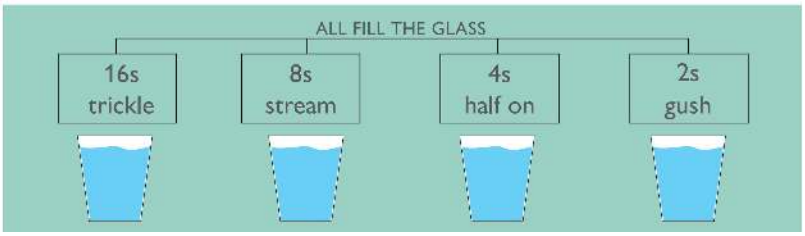
Since aperture regulates the flow of light (more light or less light), we can see this same relationship when we fill a glass with water. The illustration at right is the exact same as the previous illustration, but water has replaced light and a glass has replaced the sensor. Again, more fill time is to the left and more flow is to the right. Google the title of this section you will see many examples such as this.

In the middle illustration the fill time and flow are not reversed. More water is always to the right. In this case we have to count the steps (like stops), which is two in the example shown.

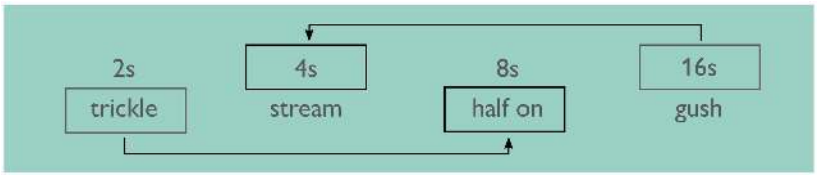
The same happens with the exposure relationship shown in the bottom illustration. More light is always to the right, so we now have to count the stops. Here the shift is two stops, but they could have been shifted any number of stops.

Changing the f-stop or the shutter speed to compensate for a change in the other is exactly what your camera does on P, A (Av) or S (Tv). This is why understanding this relationship is important. You don’t need to remember the numbers in practice, only the

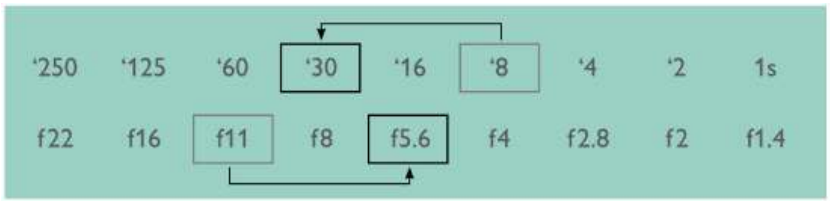
relationship as shown in the diagrams here.



Water glass analogy: Let's say you want to fill a glass with water to a specific level. You have choices as to how to do this—less amount of water for more time or more amount of water for less time. The glass is the sensor and the water is the light.



Now let's put more water to the right and more flow to the right also. If the glass needs to be filled in 4 seconds instead of 16 (top arrow), the flow has to be increased from a trickle to half on (bottom arrow).



Like the previous illustration, more light is now to the right with both shutter speed and f-stop scales. If the numbers are arranged this way, then you have to count the stops to see the same overall exposure. In this example an exposure of 1/8s is given two stops less light (to 1/30s), so to get the same overall exposure the f-stop is given two stops more light (from f11 to f5.6).

Just like the diagrams on this and the next few pages, this older camera features f-stops and shutter speeds that lock together so that turning the ring will give you different options for the same overall exposure.

With digital cameras this is also the exact same control you have when turning the main dial when you are on P, T (Tv), or A (Av) modes.

Unrelated to this discussion: notice the red flags that move with different f-stops. These show the depth of field. At f16 the depth of field will be from 5 feet to almost 8 feet when the lens is focused on 6 feet.

Since this camera used different film for different ISOs, all of its controls (aperture, shutter speed, focus) are easily changed in one place with one hand.



RELATIONSHIPS IN PRACTICE

Below are all the combinations that will give the correct exposure in this situation. The equal sign between boxes indicates that the overall exposure will be the same in the different boxes.

Since depth of field was not a concern and since the camera was handheld, the combination with the fastest shutter speed was chosen, as indicated by the bold box.



2s	1s f16	=	‘2 f8	=	‘4 f5.6	=	‘8 f4	=	‘15 f2.8	=	‘30 f2	=	**‘60 f1.4**	‘125



‘2		‘4 f22	=	‘8 f16	=	‘15 f11	=	‘30 f8	=	‘60 f5.6	=	‘125 f4	‘250	‘500

For this situation, the camera indicated an exposure of ‘60 at f5.6 with other combinations giving the same exposure shown in the other boxes.
Since it was important to have enough depth of field to have everything sharp, the main dial was moved to f8, which set the shutter speed to ‘30.
If a tripod was used and there was no wind, it could have been changed to ‘8 at f16 to ensure everything would be in focus.

Here the camera indicated an exposure of ‘30 at f4. Since it was important to have some people blurred, a ‘2 at f16 was chosen.
Notice that here the depth of field was not much of a concern. Also that a tripod was necessary.



4s	2s		‘1 f22	=	‘2 f16	=	‘4 f11	=	‘8 f8	=	‘15 f5.6	=	‘30 f4	‘60



With this situation (in bright sunlight) it doesn't matter which combination of shutter speed and f-stop is chosen. Any of the shutter speeds are fast enough
to not cause motion blur (even with no tripod), and everything is fairly far away (at infinity), making depth of field a non-issue.

This example was taken with a fast lens in which the aperture opens up to f1.4, and only stops down to f16.
Here the goal was to have a lot of softness in the foreground plants, so an f-stop of 1.4 was chosen.
If the goal was to have all these plants in focus, even at f16 they would not be (they are too close). Also a tripod would have been necessary.



ISO & Exposure

ISO influences the shutter speed and aperture you use. Higher ISOs will allow you to use shorter shutter speeds and/or smaller apertures.
As noted earlier, setting the ISO higher comes at the expense of quality. But many times it is the only option.

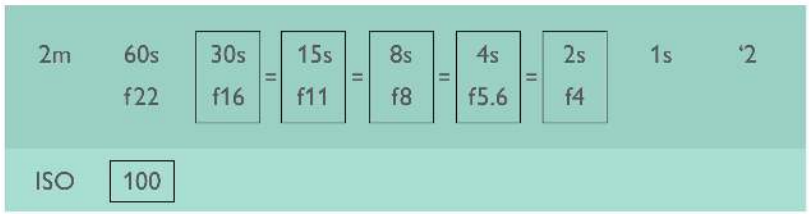
When you find yourself taking photographs in a situation where your shutter speed is too slow, set your ISO higher to take the photographs. How much higher depends on how high you need to go to get a shutter speed you can reliably count on to avoid

motion blur.

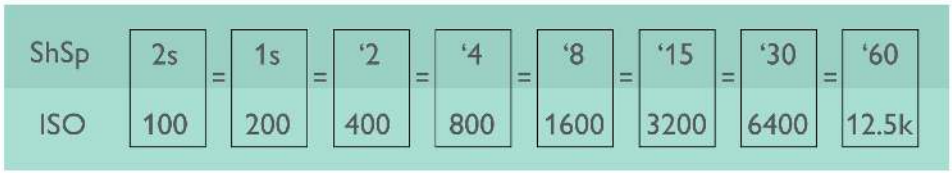
The same thing is applicable to f-stop. If you need more depth of field you can set your aperture to a smaller opening with a higher ISO setting. But usually a photographer increases the ISO to allow a faster shutter speed to minimize motion blur.

Study the illustrations at right and understand them. As with the relationship of shutter speed and aperture, you don’t have to memorize any numbers since the camera will do the math for you. But you do need to understand the relationship between ISO and

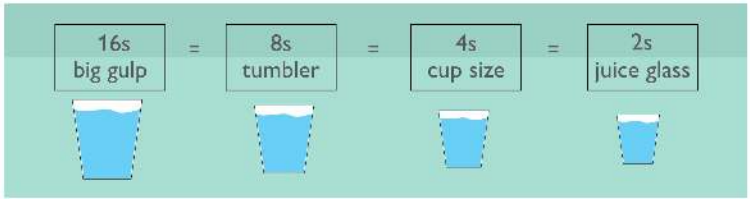
shutter speed or aperture. And of course, the concept of a stop.



A lighting situation in which there is little light present. Notice that the shutter speeds are in full seconds. If you have a tripod, and nothing is moving, no problem. But what if things are moving? How do you get a shorter shutter speed? See the next illustration.



Each doubling of ISO number makes the sensor 1 stop more sensitive to light. Here there are 6 doubles (stops) from ISO 100 to ISO 6400. So, by changing to ISO 6400 your shutter speed is shortened to '30s for the same overall exposure. This could have been shown with ISO and f-stop instead.

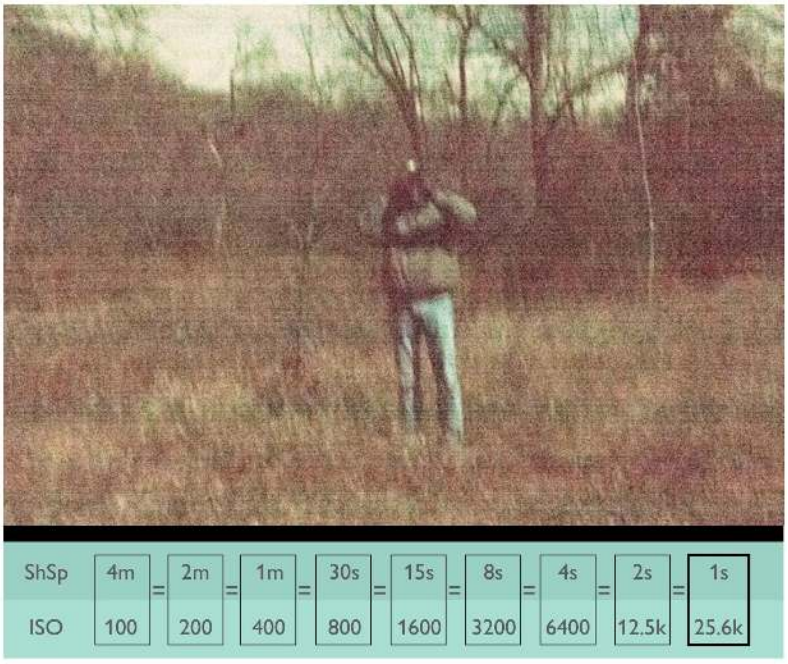


Water glass analogy again: Here ISO is equated to the size of the glass, so instead of how much light the sensor needs, it is how much water the glass needs. The smaller glass (higher ISO) needs much less time to fill than the larger glass (lower ISO).



In this example, any of these shutter speed/ISO combinations would give the same exposure. Here the ISO was set to 25,600. This allowed for a shutter speed of ‘60 with the aperture wide open (as wide as possible—in this case f2).
The camera used did not have image stabilization, and it was taken at the end of a long day, so it needed to be taken at a shutter speed of at least ‘60 to keep the image from having motion blur from camera shake.
As you can see from the numbers in the diagram, at ISO 100 the exposure would have been 4 seconds. Surely not practical for this situation!

This photograph was taken in the middle of the night using only the light of a half-moon. As you can see, no tripod was used. Any of the shutter speed/ISO combinations would have given the same exposure, but at ISO 100, the exposure would have been 4 minutes.
Even at ISO 25,600 the exposure was 1 second, not fast enough to ensure camera shake would not blur the image.
This image begs the question of why it was even taken. It is a long and uninteresting story.



Manual Exposure

If you need to set both the aperture and the shutter speed independently, the M (Manual) mode setting on the camera’s main dial lets you do just that.





First set the mode dial to ‘M’, then (on most cameras) turn the main wheel to change the shutter speed. To change the aperture, you either turn another wheel or hold down the +/- button while you turn the main wheel. If this doesn’t work with your camera, it is time to pull out the instructions to see how it is done.

In manual mode, you control both the shutter speed and the aperture. You can still access your camera’s light meter to see what it suggests, and as a matter of fact, you can get the exact same control as you have with P, A (Av), and S (Tv) modes.

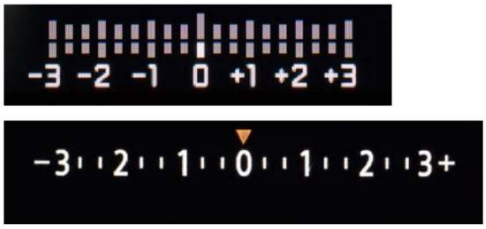
Hopefully you are using the EV scale introduced in the Exposure chapter. In manual mode, this EV scale becomes a pointer that allows you to see the exposure your camera recommends compared with your settings.

As you turn your shutter speed and your f-stop to different numbers, the pointer on the scale will zero. When it is at zero, your exposure will be the same as if you had your camera on P. If you turn your f-stop or shutter speed so that the pointer is -2, this would be the exact same exposure as if you were on P with EV-2.

In practice you don't use Manual (M) mode that way. If you wanted to use your camera's suggestions, you would just use one of the other modes. Quicker and easier than manual mode.

Manual Mode When?

So, why would you use manual mode? There are a variety of reasons, but it all boils down to using it when you need to. There are many situations in which your camera's suggestions will fail you, but what follows are some of the more common or representative ones.



When on manual mode, the EV scale becomes an exposure scale. Centering the pointer on zero will give you the same exposure as having your camera on P, Av, or Tv (P,A,S) with no EV adjustments.

High Contrast Scenes

One situation where the auto modes fail is with very contrasty scenes—those which have very light and very dark areas. These can fool your camera's light meter to the extent that it is useless.

In this case, go to manual mode and try different f-stop and shutter speed combinations until you get the correct exposure as indicated in your histogram and your review image. Sure, it takes a while, but that may be your only choice.

Sometimes it is difficult to know when manual mode is the best. The situation on the upper right is contrasty, but perhaps not too contrasty to be compensated for with an EV of +3 or +4.

In practice, it becomes clear when you are in a situation where the automatic modes are not working. It simply becomes easier to set your camera on manual mode and experiment with different exposures.



ABOVE The range of light in this historic prison cell was amazingly broad, with the light from the window hundreds of times brighter than the interior.



LEFT Jon Runaas. It is impossible for a light meter to average this contrasty light situation.
RIGHT Jessica Grant. This is a small detail of a larger image. In the original frame there was so much dark sky that the camera meter would fail spectacularly. In this situation, expect your meter's suggestion to be off by around 10 stops—far past the range of your EV scale on the automatic modes.



Changing Scenes

Taking photographs of Elvis proved to be impossible on any of the automatic modes. Except for the static dip shown, Elvis was moving around constantly. Like cats, Elvises (Elvi?) that are awake generally have a hard time being still.

As Elvis got closer, he got bigger in the frame, so the EV compensation needed was less. When he moved away, the needed EV compensation was more. To make matters worse, there were a number of Elvises, each with different clothing (lighter and darker).

The one thing that was constant was the main spotlight on all of the Elvises. So, his (their) brightness really didn't change at all.

The solution to getting good exposures in this instance was to set the camera on manual mode. The correct exposure was then found by trial and error (actually it isn't that hard to guess once you get used to those darned numbers).

After the correct exposure was found, the rest of the night, through many different Elvi (?) the exposure remained, like the song, the same.



ABOVE Elvis in what appears to be a combination of his younger and later years.
LEFT Elvis from another stage in life, this time in a dark suit. This was taken at the same exposure ('60 @ f4 ISO 400) as the image above and all the images of Elvises I shot that evening.
I heartily recommend going to one of these competitions. Just once is enough though.



Unusual Light

There are many situations like the Elvis one that are hard to describe, but certainly need the camera set on manual mode.

As you experiment more with photography (isn't every photograph you take an experiment in a way?) you might go well beyond what camera designers planned for automatic exposure.

Light painting, which is covered in the appendix, is one many techniques where your camera's meter is as useful as your appendix. Get it? Ugh.

Or Christmas lights. Or fireworks—your camera might have a setting for these, but using manual exposure will give you more control and better images.

Lightning is easier to photograph than you might think. Just set your camera on B and hold the shutter open until the lightning itself exposes the sensor. Experiment with different f-stops.

The list continues. If it emits or reflects light, it can be photographed. But sometimes only on manual mode.



Megan Rash, light painting



There was a lot of light pollution in this photograph of stars traveling around the North Star. The exposure time was 25 minutes.

External Flash

When you use your camera with an external flash (covered in the next chapter), your camera's meter is useless since the light only lasts for a fraction of a second.

The flash itself defines the exposure time, so your shutter speed needs to be set to 1/125s (with most cameras). Now you use either your aperture or the flash's output control to adjust your exposure (you could also use the ISO). The light meter (and the automatic settings) in your camera are completely worthless.

You can also use the manual setting to control how the flash on your camera can be mixed with existing light, but that is a subject

for another day, another book.



Prom night with studio flash

Two Doors

The shutter is actually two sliding doors—one opens, then another closes after it. With shutter speeds faster than (usually) ‘125, the second door starts to close before the other is fully open, hence at faster shutter speeds a moving slit exposes the sensor. Using a flash at higher shutter speeds exposes only the slit of the shutter open during the flash.

Instead of the door type of shutter (called a focal plane shutter), a few cameras use an iris shutter that opens and closes like the aperture. With iris shutters flash pictures can be taken at any shutter speed.

Charles Kunene, self portrait with monolight







Panorama of Grand Tetons made from five overlapping images

Multiple Images

Even though your camera may have a panorama setting, you will get better quality by taking a number of overlapping images and stitching them together in an image editing application such as Lightroom or Photoshop Camera Raw (see appendix). The panorama will also be better if all of the images are the same exposure. To do that, set your camera on manual, find one exposure that will work for all the images (by trial and error), then take all of the panorama images with this exposure (shutter speed and aperture combination).

This technique works well whenever images are to be used together, such as with time-lapse and animated GIF (cinemagraph to be fancy) images.



Still images from an animated GIF. Manual exposure settings ensure that both images are exactly the same lightness for a smooth transitions between the extrovert and introvert images.

Dial Paraphernalia

You have probably noticed that the mode dial on your camera has a lot of other settings. Maybe you are patiently waiting for me to explain them. Okay...

Most of these settings are fairly worthless once you know as much as you do now. For instance, Sports mode will opt for higher shutter speeds than program mode, but you can easily better do that by choosing the shutter speed you need.

There are a few modes that you may find useful. Movie mode is of course one of them, and if your camera has custom modes, those are also useful.



Camera Instructions

Now that we are done looking at most of your camera options, it is good time to investigate your camera instruction manual to see if there are settings hidden there that might be useful to you.

For example, I have a camera in which too much of the viewing image is hidden when showing the histogram. But there is a setting which shows highlight clipping on the viewing image—it doesn't block the view, but does show me the most critical information for which I need the histogram.

You may find many settings that only apply to JPEGs saved from the camera or ones that only apply to automatic mode. You don't generally need these.

Now Go Shoot

With your camera on P, see how much you can change your shutter speed and f-stop by just turning the adjusting wheel. Notice how your shutter speed compensates for aperture changes. See if you can interpret subjects using these controls.

Take some photographs using your Manual (M) setting. Just to get into the history of it all—that is the way photographers shot before automatic exposure.

Try some unusual lighting situations such as the ones in this chapter. Can you use the program mode with EV compensations or do you need to switch to manual mode in different situations?

The Moon

Photographers have long known that the sun is a fairly constant light source. Good exposure under bright sunlight can be calculated as approximately [ISO speed used as shutter speed] @ f16. So, with an ISO of 100, the exposure would be 1/125s (close enough) @ f16.
A scene lit by a hazy sun might need a bit more exposure (and a cloudy day even more), but you can try this with your camera set on manual mode, and you will see that it holds true.
Since the moon is illuminated by sunlight, one would expect that a photograph of the moon would require much the same shutter speed and f-stop. It does, although a few stops more might be needed to compensate for the filtering effect of the atmosphere or light clouds.
So, do you need a tripod to take photographs of the moon? No!

EXPERIMENT

In the previous experiments you did comparisons. This one is a little different, and is intended to have you gain familiarity with difficult lighting situations in which you need to use manual mode.

Go out tonight with your camera set to manual mode. In the dark, look around and take photographs of what you find. It will not be difficult to find things where automatic exposure doesn't work.

Try different shutter speeds and apertures. You know enough at this point to use either a larger aperture or a slower shutter speed if your image turns out dark. Just take and retake until you get the right combination.

If you have a tripod, that would certainly be helpful with this experimental shooting, but if you don’t, think about celebrating (and controlling) motion blur. And be safe. There are lots of things you can trip over and bump into at night. Some might even want a

camera so they can use this book.



Dianna Zierke



Laura Grevas



Alicia Ford



Alex Stoffrengen

Exposure Controls Questions

For the next three questions your life will be easier if you have a pencil or something to count the stop changes with. You could instead enlarge them and use your finger.

Notice that the stop changes are all ordered with more light to the left.

If your exposure was 1/125 second at f4, what shutter speed would give you the same exposure at f5.6? At other shutter speed ans f-d stops?
shutter speeds in stops: ‘4 - ‘8 - ’15 - ’30 - ’60 - ‘125 - ‘250 apertures in stops: f2.8 - f4 - f5.6 - f8 - f11 - f16

If your exposure was 1/30 second at f8, what aperture would give you the same exposure at 1/125th? At other shutter speeds an f-d stops?
shutter speeds in stops: ‘4 - ‘8 - ’15 - ’30 - ’60 - ‘125 - ‘250 apertures in stops: f2.8 - f4 - f5.6 - f8 - f11 - f16

If your exposure was f8 with an ISO of 800, what f-stop would give you the same exposure with ISO 100? At other ISOs and f-stops?
apertures in stops: f2.8 - f4 - f5.6 - f8 - f11 - f16
ISO in stops: 100, 200, 400, 800, 1600, 3200

What mode allows you to set both the shutter speed and aperture independently?

What can you use to see what exposure your camera recommends while on manual mode?

What type of scene might necessitate using manual mode?

What setting on the mode dial would be good to use when taking a series of photographs for a panorama?

What shutter speed would you use for light painting (very approximately).

What shutter speed is generally used with an external flash?

When does the book suggest you use the flower setting on your mode dial? (trick question)



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9.1: 9PH PHOTOGRAPHS AS DOCUMENTS



To take a photograph of something is proof you were there. Proof that the thing photographed actually existed. Everyone takes photographs to document things, whether it is a birthday party, the Grand Canyon, or the color of your hands after eating Flaming Hot Cheetos. You see these photographs every day, and sometimes they elicit an ‘ugh’ (like you really want to know what your ‘friend’ had for dinner).

The image above is a photograph of a t-shirt (I know there are other things, but the shirt is the point). Something about the phrase One Rack Mind interested me, or puzzled me… I don’t know, but I couldn’t figure out the phrase nor its relation to the people in the fraction of a second after I saw it, so I took the photograph to communicate it to future me so that he could perhaps figure it out at his leisure. Nothing earth-shattering, just a little note—certainly not something I would want to include in a book on photography (oh well). I think I was just intrigued by the levels of the pun.

Documentary photography has been around since there was photography. How could it be otherwise? These little mirrors with a memory we call photographs excel at recording what is there. While photojournalism implies a responsibility to a truth, documentary photography is generally considered much more fluid in its interpretation of reality. Bring your attitude, bring your opinions—documentary photographs are the editorials of photography.



With the second image shown here, it is obvious that it is a tent (I think), but since it is taken out of context, it says little or nothing else. You could even claim that in order for it to be a document more context or more story would be needed. It certainly couldn’t be claimed as photojournalism. Perhaps with more photographs or at least a caption to go along with it you could claim that it would be the editorial photograph that documents are. But as it stands, it is simply a puzzle. It could be about how fabric stretches, it could be about how tents used to be made, or it could even be an abstract image, with a classic trapezoid contained in the rectangle of the frame.

The term documentary photography encompasses a lot, but what is clear is that the photographs are as much about the photographer’s view as the subject, although they include aspects of both. The tent might be a documentary photograph, it might

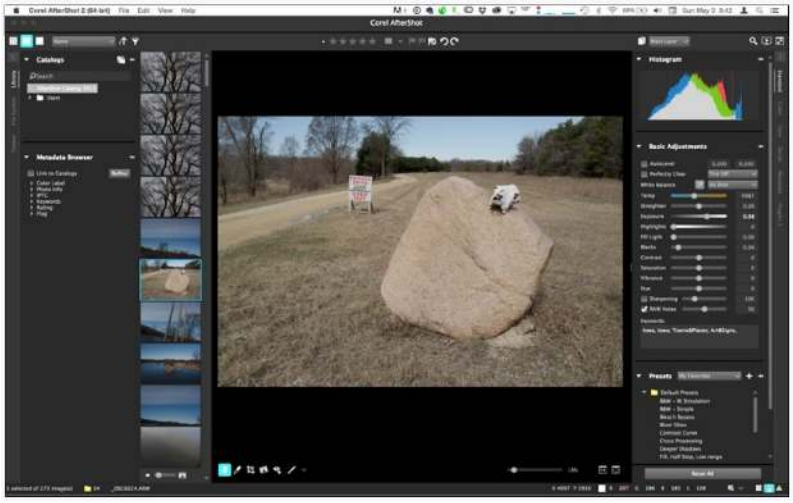
not—it is incomplete information.

During the depression, the US government tried hard to rebuild the rural economy with the Farm Security Administration (FSA). As part of that effort, the FSA hired a group of photographers to document conditions in rural America. The photographers who took part in that effort produced some of the history's best documentary photographs which stand as icons in American society. You've seen some of these images. One is **Dorthea Lange's** Migrant Mother, which is almost as famous in the U.S. as the Mona Lisa. But Lange took many other incredible images as part of the FSA (and, as many of the photographers, after the FSA). **Walker Evans'** photographs are severely editorial while not looking like it at all, and many claim him as the father of modern documentary photography. **Ben Shaun** was also a painter, and it is interesting to compare how he approached each medium. **Russel Lee**, **John Vachon**, **Arthur Rothstein**, and **Marion Post Wolcott** are other famous FSA photographers. Since the FSA was financed with government funds (i.e. our money), these photographers' FSA images are available without copyright. A good place to browse images is in the Flicker FSA Group.

More recent documentary photographers include **Robert Frank**, whose book The Americans has become an symbol of the beat generation with its modern interpretation of Alexis de Tocqueville's 19th Century critique of America (de Tocqueville was French, Frank's book was first published in France). **Larry Clark** and **Larry Fink** give us frank views of subcultures. **Ken Heyman's** images are classically beautiful, while **Lisette Model's** images are gritty. **Roy Decarava** presents a black point of view, while **Mary Ellen Mark** (warm social images) and **David Plowden** (cool urban landscapes) represent the polar opposites of where inspiration from the FSA and Walker Evans can lead to.

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9.2: 9CR CATALOGING APPLICATIONS



Corel Aftershot



Phase One Capture One Pro

CATALOGUE APPLICATIONS

Although Lightroom is a very good cataloging (DAM or Digital Assets Management) application, there may be reasons to use another instead or in addition to it.

Adobe Bridge

A very light cataloging program. Very good at quickly assessing and editing batches of images.

Apple Photos

Very easy and nicely designed, without much versatility (no local adjustments, limited lens correction). Integrates extremely well with other Apple devices.

Capture One Pro

Best at image editing, with strong local controls. I have found it not great at cataloging many images unless they are broken into smaller sets, but my cataloging experience with it has been minimal.

Corel Aftershot

Very much like Lightroom, but cheaper and not quite as versatile, but may do everything a person needs it to do.

Camera Manufacture Applications

These range from not-so-great to worse, but sometimes include special features, such as good tethered shooting (viewing and shooting from a connected computer).

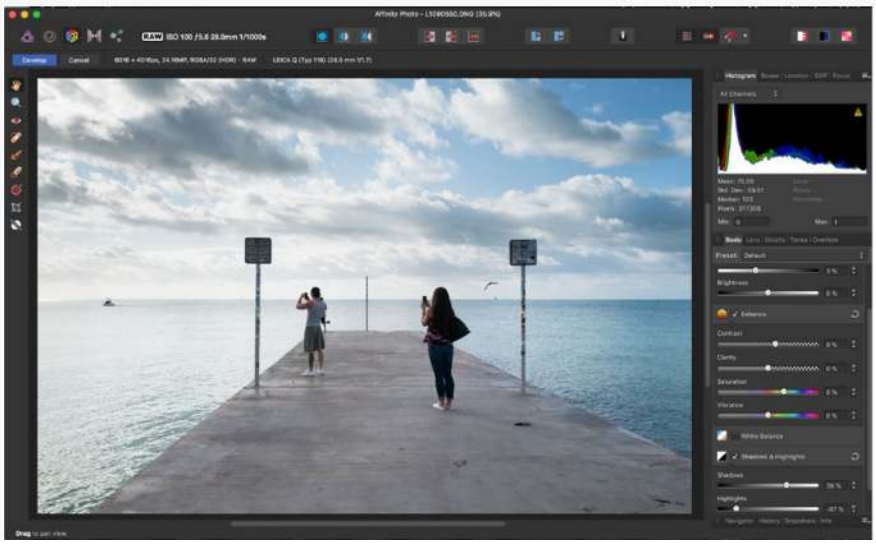
Others

There are other catalogue applications you can easily find on the web, such as Alien Skin's Exposure. Most programs have free trial versions you can use for a month. RawTherapee and Darktable are open-source and free. There are also web-centric image cataloging methods such as Flickr and Google Photos.

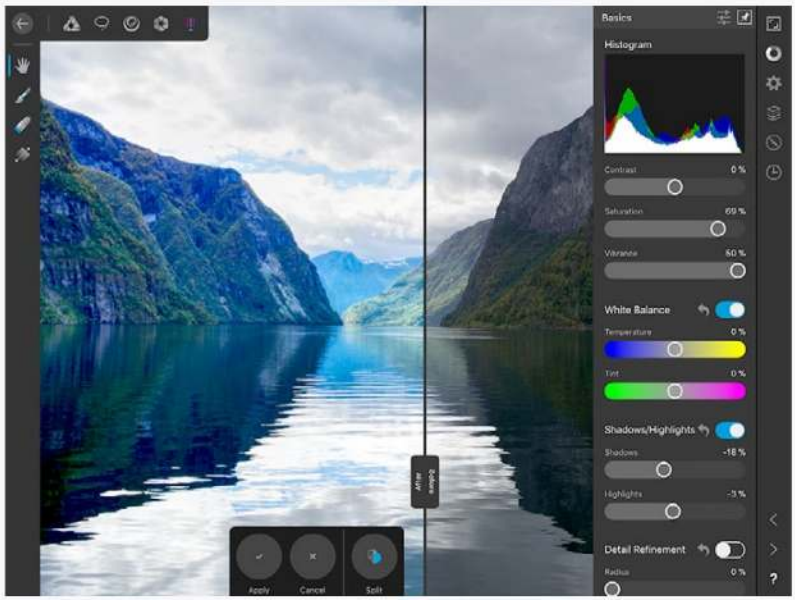
Lightroom

Lightroom comes in two different versions (Lightroom CC and Lightroom CC Classic). These pages have covered the Classic version.

The non-classic Lightroom is striped down and has a ‘groovier’ interface. It is also made for mobile devices such as an iPad. Lightroom uses an ingenious system to synchronize one catalogue with all image adjustments across devices. A limited version is free to try out.



Affinity Photo



Affinity Photo for iPad

EDITING APPLICATIONS

Without cataloging capabilities, these applications are narrower in focus and generally can do many things catalogue programs can’t. So, while this book is about improving images, it is not about manipulating images (to any extent). To combine images (&c) you need an image editing application such as one of the following ones. There are too many others (such as Luminar) to cover here.

Photoshop

The best, meaning that it is the most versatile.

Affinity Photo

A solid and inexpensive application. It does all of what many photographers would need it to do.

Pixelmator

A well-respected and inexpensive application.

Gimpshop (or Gimp or Seashore)

Free versions of open-source software. Many compare these with older versions of Photoshop. Fairly versatile and you can't beat the price. While all of these are basically the same application, they have different user interfaces applied to them.

Others

There are many photo editing applications out there. You can usually download an application and try it for free. Everyone's needs are different for editing images, so it might take some time with Google to find one that is right for you.

Tablet and Phone

There are also many applications for tablets and phones made to edit images. Although not as featured as computer applications, some deal well with RAW files, and all are easy to use. Affinity Photo (shown above) is one that has impressed me. For $20 (at the time of this writing) you can't go wrong. Unless you don't have a newer iPad.

Photoshop is also available for mobile devices. At the present time it is only suitable for compositing, but Adobe promises more to come.

If you want to add drawing or painting to your photographs, there are tablet applications such as ProCreate which have many controls for this.

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10: Lighting

Light is crucial to photography. Yes, I know I have said that the lens is crucial. The sensor is also crucial, but light? That is really crucial. I mean it this time. Every photograph you have ever seen has at least one light source.

For this discussion all light sources—from a candle to the sun to the light reflecting from a wall—is the same. In photographic terms, they are pretty much the same.

Three Variables of Light

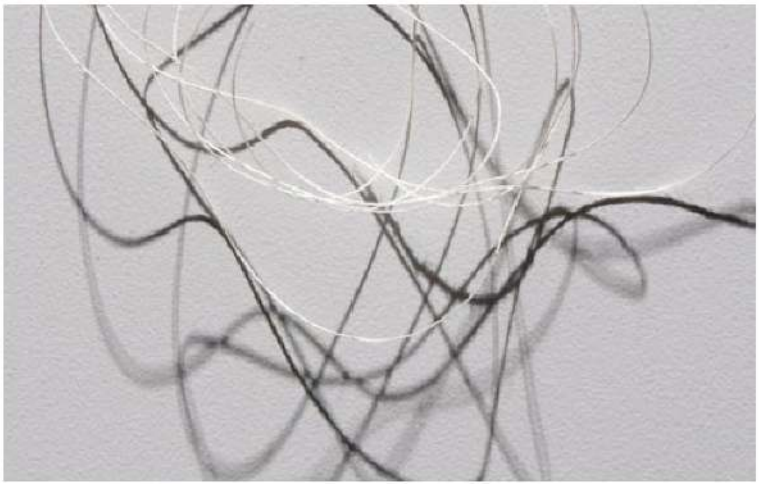
At its heart, lighting is pretty simple. There are only three variables—the size of the light source, the direction of the light source, and the number of light sources. There is one caveat to these, however, and that is that the word effective needs to be added to each of these variables. For example, the sun is quite large, but since it is very (very) far away, it functions as a small light source in photography.



As a matter of fact, look at the moon, which is visually the same size as the sun (but easier on the eyes) and you will see that it is about the size of a pea held at arms length. Hence, it is effectively small.

1) Size of Light Source

The effective size of a light source determines the sharpness of the shadow an object casts. A small light source will cast distinct shadows with hard edges. This is called hard light. The sun is a handy example of an (effectively) small light source. You have seen the shadow that you cast when the sun hits you. It is dark and the edges are distinct with sharp edges.



ABOVE White thread and its shadow from a small light source.
BELOW The sun is effectively small, casting distinct shadows with sharp edges.



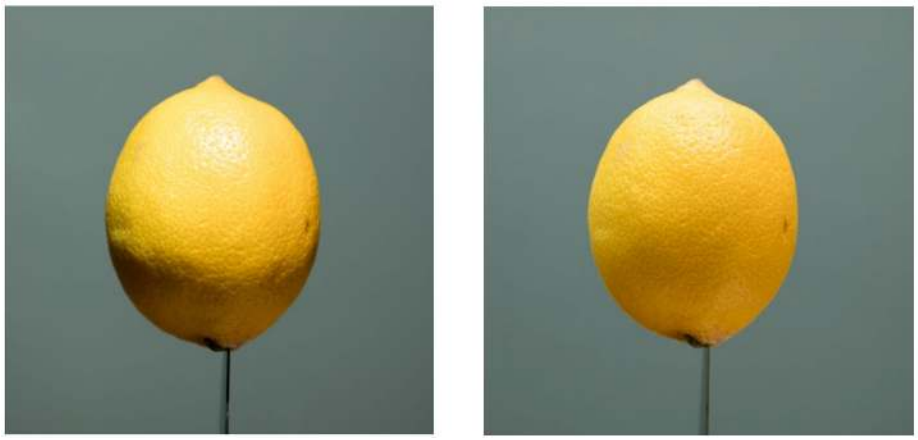
Another small light source is a flashlight, which is effectively about the same size as the sun (much smaller but much closer). This light will cast very similar shadows as the sun.

What if the sun goes behind a cloud, or it is an overcast day? The sun is no longer lighting the scene directly, and it is now the sky that is the effective light source since the sun itself is blocked. The sky is a very big light source, so the shadows are very soft and indistinct. This is called soft light.



The shadows here are very soft and indistinct. The effective lighting is the dome of the sky.

The quality of the shadow cast by a light source is very important and extends beyond just the shadow you see. The way texture is perceived largely depends on many small shadows on the surface of the subject. Since small light sources produce distinct shadows, they show texture much more readily (see illustration below).



SIZE OF LIGHT

Lemon with small light source (left) and large light source. Notice not only the distinctness of the shadow, but also the interpretation of the texture and the reflections.

This is the reason portrait lights are always bounced off of umbrellas or filtered through material—these things make the effective light source larger and so reduces the texture of the skin, which is made up of not only big pimples but many smaller irregularities that would be exaggerated with the sharp shadows of a small light source.

Reflections are also more distinct with a small light source (look closely at the lemons on the previous page). Everything is reflective to some extent, and the reflections help to determine how something looks. This is the reason that actors and newscasters get their faces powdered before being on camera. The powder reduces reflections from various parts of their faces. You are accustomed to seeing these reflections when you speak to someone and so do not notice them. The camera is not so kind.

2) Direction of Light Source

Also influencing reflections and texture is the direction the light is coming from relative to the subject and the camera.

Hard light (from a small source) coming from near the camera will show less texture than light raking across a subject. Another way of thinking about this is that the shadows from the light near the camera are smaller, so less noticeable than the longer shadows of raking light extending across the subject.



DIRECTION OF LIGHT

Light coming from above (top) and from the side. Light from the side is more interesting, although straight from the side like this is fairly unusual.

Reflections from light coming from near the camera will be also be more noticeable since the light reflects back at the camera. You may have noticed this with flash pictures of friends, especially if their skin is not freshly washed (if it is oily). The flash is a small light close to the camera, so the reflections from that oily skin are exaggerated.

There are other things that change when the direction of the light changes. The following are some examples:

The classic way to scare the bejeebers out of little kids is to hold a flashlight so that it points up at a face. In natural settings light is rarely seen coming from below, so it scuttles expectations and causes anguish (well, at least to little kids).

Light coming directly from the direction of the camera (think flash, license photos, and mug shots) is rarely pleasant since shadows that define features and give faces volume are hidden.

When the light source is small, light from straight above a subject (like a noon-day summer sun) is also unpleasant. With people it causes a shadow covering both eyes and large shadow under the nose (like Hitler's mustache!). With other things light from above is not as objectionable, but certainly not inspired lighting or particularly interesting.

Light from behind the subject (called back-light) is great for some things, since it is unusual. But many times it is useless since it does not reveal the subject.

This discussion leaves only one light direction option left—light from the side. With a hard light (small source), this lighting can be very dramatic. With soft light (large source) it can be very pleasing.

Of course, light from any direction can be effective if it is used well, and light used by photographers often doesn't come strictly from one of these directions—it may come from the side, but also up and toward the camera. Or a hard light from almost behind the subject, illuminating just a sliver of it. The dome of the sky lights from many directions at once.

Also, one light is often used in conjunction with other lights, although one light source can be very effective as you can see from

the examples on the next page.



ABOVE Back-lit waterfall. Imagine if this didn't have the water. Pretty boring in this instance.
LEFT Silhouettes are about all you get with back-lit opaque objects.



LIGHT DIRECTION WITH ONE LIGHT





One soft (large) light can be very effective LEFT Somto Mogbogu, light from above LOWER LEFT Megan Howe, light from above and to the left RIGHT Becky Urlaub, light from below. When you see a photograph you like, try to figure out how it was lit.



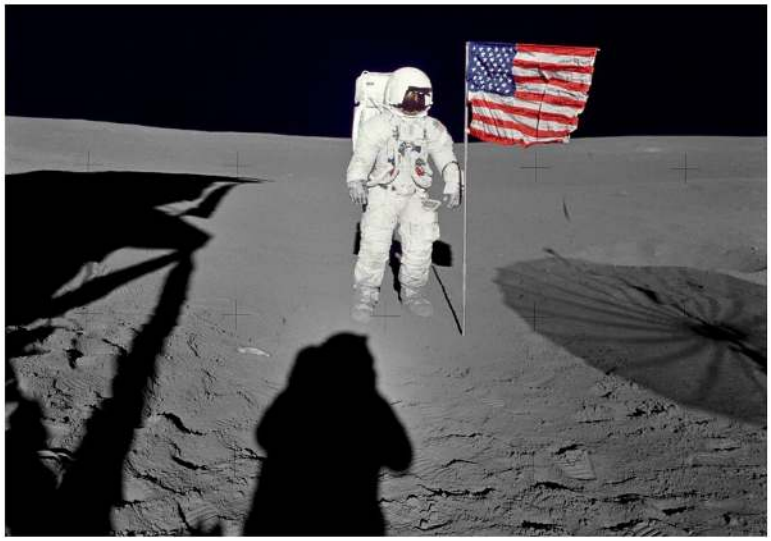
3) Number of Light Sources

More than one light is almost always used with any photograph. Imagine a snapshot on a sunny day. There is the sun (a hard small light) hitting the subject, but there is also the dome of the sky (a soft big light) also hitting and illuminating the subject. What the photograph reveals is a combination of these two light sources.

The secondary light sources can be subtle. On a snowy overcast day, the light source is the sky, but the reflection of the light from the snow acts as a second large (soft) light source giving the subject almost 360 degrees of illumination.

Many times (either in nature or with lights indoors) two light sources are needed, if only to fill in the shadows to give them tonality and detail. These light sources can be reflectors reflecting the main source (the sky is actually a big reflector for the sun), or actual lights themselves.

Of course, this doesn't mean you have to carry reflectors and lights around with you. Nor do you have to think about all of this as you photograph. Just be sensitive to the light. Really look at it.



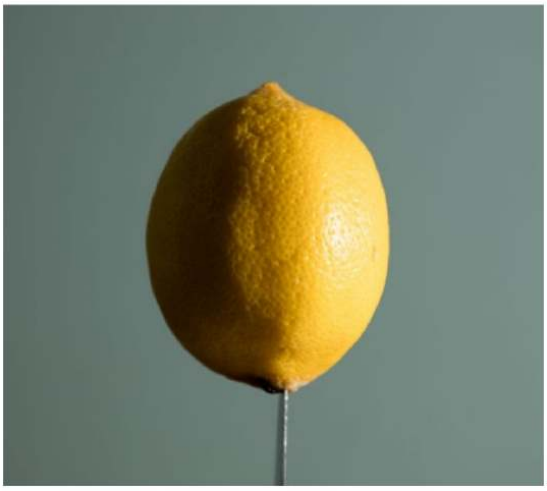
NASA image. Why are the shadows so dark? —There is little atmosphere (sky) to act as a light source to fill in the shadows with detail. This is also why the sky is black, not blue.
In other words, only one effective light source (the sun) was used.
The unnatural look of this lighting is more familiar from studios. Perhaps this is one reason for the conspiracy theories of faked moon landings.

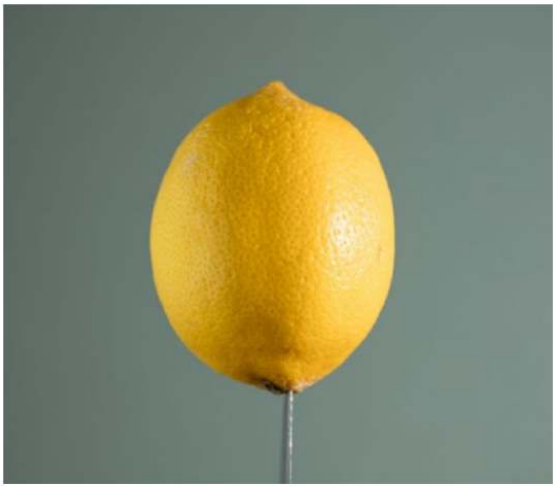
Size, direction, and number of lights are the three things that influence how light looks. It may seem pretty simple, and in its basic form, it is. But there are many permutations that can complicate things. What if you have a light reflector with a faceted surface? — Is it one large light or many small lights? Or a soft light coming from both the side and in front of the subject? Things get complicated pretty quickly because all of these variables of light are actually continuums that work together.

One could argue that there are other variables, such as how coherent the light is. This might describe how a matte reflector makes different kind of light than a polished reflector. But these are subtleties outside of the range of this text.

NUMBER OF LIGHTS

To the one light used on the top image a second light was added in the bottom image.





What follows are several issues with lighting. Although these things are not part of the variables of light, they do influence how you use light.



Here the main light is coming from a window on the left. A white wall on the right is acting as a second light source to fill in the shadows on the right side of the person.

The Color of Light

The color of the light hitting a subject doesn't really have much to do with how a photograph looks—as long as the light contains the colors necessary to reveal the subject's colors. You can always balance out whatever color there is or add any color you want. This was covered in the Sensor chapter.

In the context of the current chapter, the color of light is important when you have multiple light sources of different colors, which is called mixed light. For instance, if there is a window illuminating half of a subject and an interior light illuminating the other half. The window side of the image will probably be blue compared to the interior incandescent lighting the other side of the subject.

This is not a problem if you want your photograph to be half blue tinted and half orange tinted. But if you want the color to look natural, you have problems. There is no real solution to this other than changing the light situation, although it can sometimes be improved in an image editing program that allows for local controls.

Also watch for light reflecting from color objects. If sunlight is reflecting off of green foliage to illuminate a side of a face, that side of the face will be greenish.

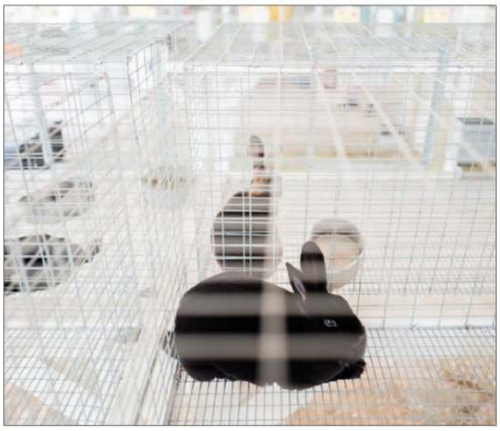
More about Reflections

Every surface of every thing reflects light. Some surfaces, such as a mirror, reflect this light directly and coherently enough to reconstruct an image of what it is reflecting.

Other surfaces, such as a shirt, reflect the light in a much more scattered fashion. This is why we admire ourselves in mirrors, not in shirts. The light reflected from a shirt is too scattered to reflect an image.

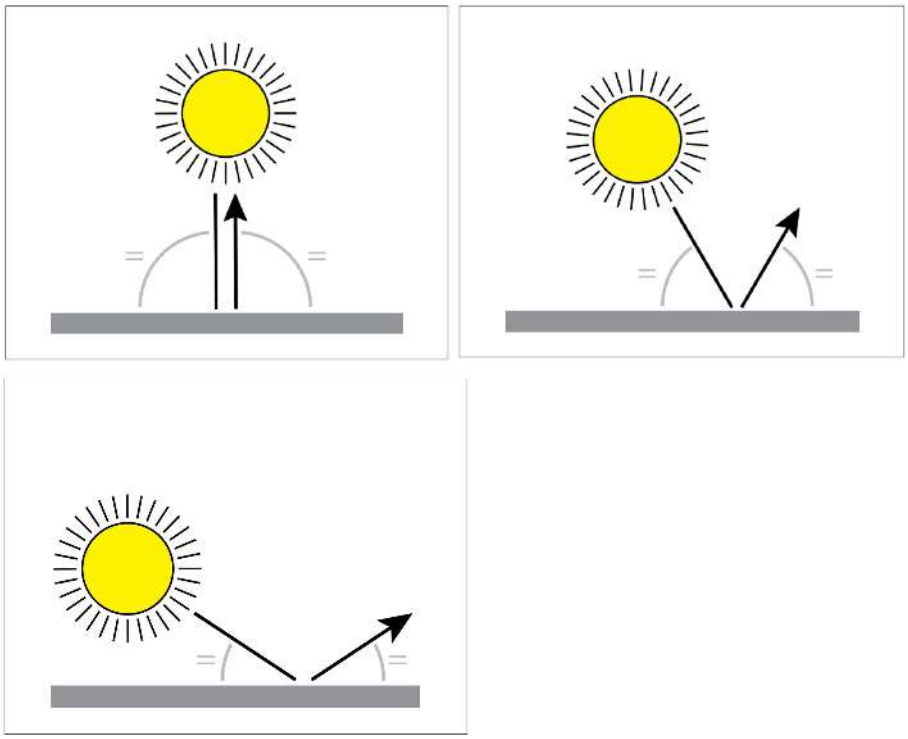


ABOVE The walls of this chapel are all the same color. The farther part of the chapel is lit by incandescent light, while the nearer parts are lit by daylight from windows.
To avoid this mixed light one could photograph at night, lighting all of the chapel with the same type of lights.
LEFT It was pointed out that light reflects off every surface, but this rabbit may be the black hole of bunnies



Dark objects reflect less light than light objects (of course). This is a good thing, because it is what photography relies on to make an image!

Whether it is a mirror or a shirt, light reflects off of a surface at the same angle from which it hits that surface. You can easily see this when you adjust the side mirrors in a car, but it is a little difficult when applied to objects which are less shiny.



ABOVE Examples of how light reflects at the same angle from which it hits a surface. It is actually the opposite angle, but let's not get confusing.
LEFT The light and the camera are at the same angle from the painting. By slightly moving the camera this reflection could have been moved away from the face in the painting.



Objects that are not flat like the painting shown on the previous page also reflect light in the same way, although it is more difficult to readily see because of the curves of the object.

In practical terms, what this means is that you should watch for where the light is coming from and discern how the reflections are influencing the interpretation of the scene.

Reflections can help define an object or they can obscure it.

Light Falloff

Light gets dimmer the farther from the source it is. Of course you know this, but it is important to keep in mind. With a light source like the sun this is not an issue. You don't have less light if you walk away from the sun—the distance you are moving is infinitesimal compared to the total distance from the sun. But if a window (or a candle) is lighting the scene, suddenly the distance at which the light gets dimmer is very important.

Portraits

Since you know something about photography, at some point you will be asked to take a portrait.



The coat of arms on this strange pew decoration is closer to the window than the background is. This makes the background dark, which in this case helps to highlight the main subject.
Using light falloff is one of the easiest methods of darkening a background.

Big Lights

Still photographers use fairly small lights, since light falloff can be easily controlled. In movies, where people are walking around, big lights that are far away are needed.
You don't want the actors getting brighter or dimmer as they walk towards or away from the light.
Percentage of the distance from the light is key here. Putting lights far away reduces the percentage of the distance changed when walking.

There are many ways to light a portrait. From this chapter you already know that you are probably going to be looking for a soft (large) light sources.

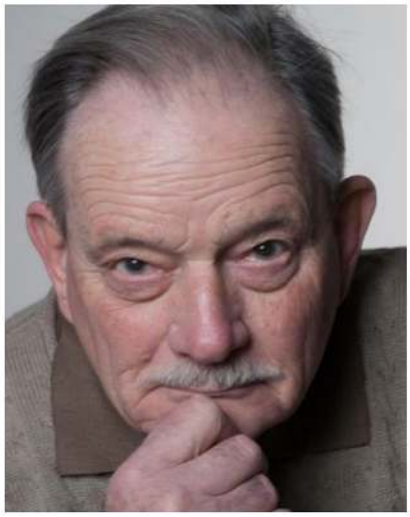
The question you need answered is how the portrait will be used. With the common portrait lighting set-up shown below there are two lights set above and to the right and left of the subject. One of these lights is called the main light, and does the primary job of illuminating the subject. The other of these lights is dimmed (or moved back) to provide about one stop less light than the other to illuminate the shadows. This is the fill light.

You can also add a third light for controlling the brightness of the background. This is called a background light (of course). Other lights can be added, such as hair lights pointing towards the camera to illuminate the side of the hair to give extra highlights and depth.

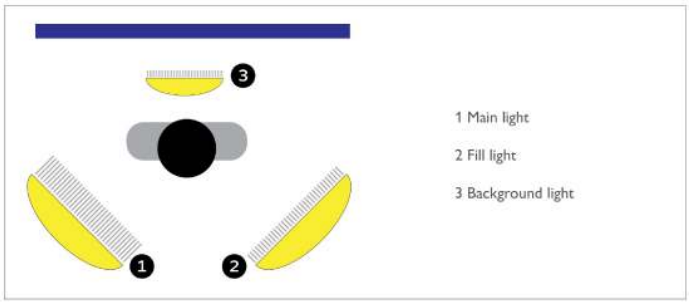
The standard portrait situation depicted in the illustration here is only important as a point of departure. It serves a purpose, but the

most interesting portraits depart from it quite a bit. See the photographs on the next page for proof of this.





Three portraits all using two lights. The one on the left was for a passport, so the brightness of the lights was fairly even, with the light on the left being about half as bright (a stop) as the one on the right. The center image was for a business card, and the lighting ratio was increased. The third image was a publicity photograph for an artist, so the fill light was set very dim for more impact.



Standard portrait light set-up as seen from above

PORTRAIT LIGHTING





TOP LEFT Katy Hora, three desk lamps pointing from the area of the camera are used to illuminate this scene
TOP RIGHT Beth Anderson, one monolight with a soft-box was used
BOTTOM LEFT Kalyn Ertz, light from a window
BOTTOM RIGHT Tessa Knosp, single desk lamp high on the left
The point here is that successful portraits (and other things) can be taken with a wide variety of different lighting situations.
By the way, often you can see an image of the light source reflected in the eyes of a portrait. However, in commercial images sometimes every reflection but one is retouched away.

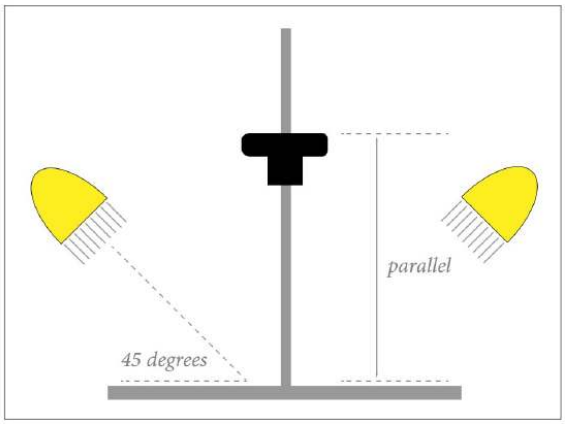




Copying Flat Material

There may be situations where you need to photograph flat material, be it paintings you did in kindergarten or family photographs that need digitizing.

There are two directives related to this. First, the material needs to be as parallel as possible to the back of the camera. Second, the lighting needs to be as even as possible without reflections. If you just take a photograph with the flash on the camera, the light will bounce right back to the camera and the image will probably be washed out by reflections.



A copy stand ensures that the lights are in a position where reflections are directed away from the camera.

A copy stand is made for copying flat things, and ensures these requisites will be met. Without a copy stand you can improvise. Perhaps by copying the material on a porch where the light is coming from the side. Or by using a window that is to the side of what you are photographing.

There are further instructions contained in the appendix of this book.

Light Types

Light originating from the sun is called natural light. It is wonderful source, whether it is coming through a window, reflected off a wall, in the shady area next to a house, or even shining directly on the subject. Ambient light, or existing light, is light that happens to be around. Maybe a living room light, or the fixtures in a ceiling, or natural light.

Ambient light can be fine, but also can be awful. There are times when you need lights made for photography. What follows are the main types.

BUILT IN FLASH: Your camera's built in flash is not a controllable light. It is small (hard), and it comes from only one direction (not an ideal one). It is also only good for illuminating things close to the camera. But it is convenient when you have to have a bit more light, and you can even turn it on outdoors when you need to lighten the shadows in a scene.

CAMERA FLASHES: These are bigger flashes which mount on your camera. They put out much more light for longer distances, and can be aimed to bounce the light off of a ceiling or wall. Often you will see these being used with various reflectors to split the

light so that part of it can bounce and part be directed to the subject. These flashes often integrate into the camera's automatic controls.



Camera flash

Many flashes can also communicate wirelessly to additional flashes, which can be set around in an environment and bounced or aimed through translucent boxes (soft boxes) which increase the effective size of their light source. With multiple flashes, lighting options increase substantially. You can have a lot of control using multiple camera flashes.

MONOLIGHTS: More light can be had if that portable flash is made bigger than a camera flash. These larger flashes, called monolights, also have modeling lights, which are extra (incandescent) bulbs that contribute nothing to the exposure itself, but allow you to see the effect of the light before you take the picture.

Monolights are very simple and versatile. Although the size dictates that they be used on stands, most can be powered by a battery, so some portability remains.

Monolights have wireless connections to each other and to the camera so that they are all triggered when the shutter is open. You can buy monolights in kits that come with stands, reflectors, and a wire-less transmitter to mount on the camera.

STUDIO FLASH: These are more powerful than monolights, so the power source needs to be separate from the light itself. These lights have power packs to which multiple light heads can be connected. With digital cameras the extra power these lights have is rarely necessary considering the cost and weight of them.

HOT LIGHTS: These lights are like desk lamps, but they can be mounted on stands. They are brighter, smaller, and more predictable in their color. They are constant-source (don't flash), so can also be used with video. The better ones all use halogen lamps, which do get very hot.




TOP LEFT Monolight TOP RIGHT Hot light LOWER RIGHT LED light. This particular LED light is quite small, enabling it to be easily held.



There are many types of hot lights, from spotlights to ones with built in large reflectors.

LED LIGHTS are basically the same as hot lights, but with less heat. Like hot lights, these are constant-source lights. LEDs have many advantages over hot lights. Not only do they stay cooler, they are extremely versatile and come in forms from panels to rings. They can easily be powered by small batteries, they have good color, and with some the color can be varied to match either daylight or incandescent. They can be made very small, and multiples of them can be put together to make large fixtures.

As LED technologies get better, these lights are largely replacing hot lights.

Light Modifiers

If you want to make a big light out of a small one, just bounce it off of a neutral colored wall or ceiling. If you want more versatility in modifying light, you could buy a sheet of white cardboard (or foam core) or cover a surface with aluminum foil. If you have enough duct tape you will be amazed at how easily you can modify light sources. And, if you can make it, you can surely buy it—there are any number of things sold to modify light sources. What follows are two which are widely used and very practical.

UMBRELLA: Photographic umbrellas look very much the same as the rain variety, but with white, silver, or translucent interiors. You simply mount your small-source light so that it points to the concave part, and the light is reflected out as a nice large-source light. These are very portable and retain much

of the brightness of the original light.



ABOVE Umbrella. Most photographic lights have mounts for umbrellas.
LEFT Soft Box. These are mounted to the reflector bracket.



SOFT BOX: Put a box over a light and shine it through a translucent bottom. Soft boxes act much the same as umbrellas in making small light sources big ones. They have some disadvantages over umbrellas, such as the fact that they block more light, making the light dimmer. But they also have advantages, such as a making the light more controllable, especially when you take into account that they come in many sizes and can be used with accessories to tailor the light.

With most LEDs putting out comparatively little light to begin with, soft boxes work best with flash. You could try a hot light in one, but get the fire extinguisher ready before you do.

OTHER LIGHT MODIFIERS: There are a myriad of different accessories that can be made or bought to modify light. Reflectors with different textures can make the reflector act like multiple tiny lights. Adjustable doors, louvers, or flags (cards) limit the light

spill and direct the light. Translucent tents can contain small subjects and soften the lights placed outside the tent to make a 180 or 360 degree light source.





TOP Barn doors are adjustable doors that limit the spread of the light.
BOTTOM flags block or dim the light hitting areas. These can also be reflective for different effects.

Often photographers use duct tape (or black gaffer tape) and various cards and reflectors to modify the light for specific instances. Lighting might seem very complicated, but often lights are only added as needed to do things such as lighten shadows or provide highlights.

Now Go Shoot

Evaluate the light source as you are taking photographs. Small or large? Is there more than one light source? Are reflections making additional light sources? What direction is the light coming from? Try different directions. How are these things interpreting the subject?

Turn your camera flash on and try a few comparisons with and without the flash. Try to use the flash when photographing closer things outside.

How good is a desk lamp for taking photographs? Turn off all the other lights in the room and try it. How about a window?

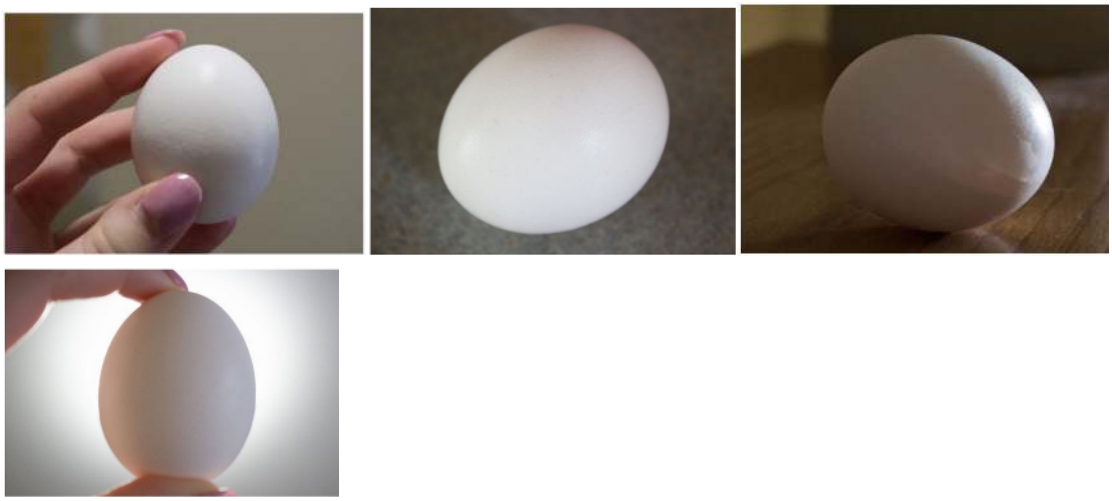
Take a sheet of paper and reflect some of the light from your small light source (sun or desk lamp) back to your subject to fill in the shadows with a smaller subject. How does this work with a large light source?

EXPERIMENT

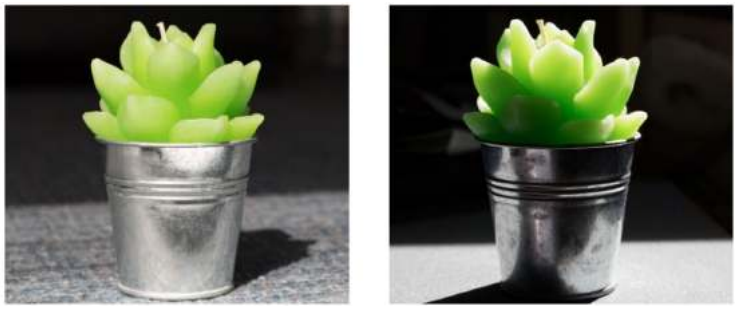
Find a simple object with a textured surface that you can carry around or that will go where you tell it to go. Place it in different lighting conditions with a fairly neutral background so the difference in lighting is the main change. Find at least eight different lighting situations (light size, direction, number of lights).

One common object for this experiment is an egg. While an egg does show quality of shadows and reflections very nicely, you do have to look closely to see texture changes. A vegetable or your hand might be better. Try to make this experiment somewhat practical and remember that this is just an experiment that will show you a bit more about light. High art can come later.

And if you are really interested, you can take this experiment and expand upon it, using multiple lights you might have handy and reflectors made of sheets of paper, boxes, and whatever else you can find.



ABOVE & RIGHT Miranda Buchholz BELOW Hanna Fox



One Last Note on Lighting

Lighting with photographic lights can get somewhat complicated and has a tendency to wait for that unbought light. Again, remember that the natural light that is around you all the time is an excellent light source. In other words...

Keep it Simple

At right is a composite image of a broken cup. Several thousand photographs were taken for this on a porch with natural light, and as the shooting progressed clouds came and went and the sun moved across the sky.

Because of this, there were a range of different colors in the image. These had to be separately color balanced for many groups of the images.

That was a lot of work, and would have been unnecessary with a more controlled light source. But it was much more pleasant to take the photographs on a nice day outside rather than in a dark studio.

Also, since the shadows necessarily changed color relative to the highlights, a certain amount of randomness was introduced, making the image a little less formal, which in this case is a good thing.



The same cup in one shot. The background for both images was the black steel photographic lighting flag you can see here.



Lighting Questions

What are the three main variables of light?

Hard-edged shadows would indicate what kind of light source? Soft-edged shadows?

What effective size of light source creates ‘soft light’. What size creates ‘hard light’?

Why does the sun behave like a small light source?

What type of light source makes reflections more distinct? Textures more distinct?

Mixed light refers to what quality of light?

What kind of objects reflect light? (trick question)

At what angle is light reflected from objects?

Why is the sun not giving you less light as you walk away from it?

How many lights are used for the common portrait situation given?

What is the main light in a portrait situation called? (this is pretty easy)

What device is made for copying flat material?

Light originating from the sun is called what?

What is the term for light existing in the environment in which you are photographing?

What is the type of flash is self-contained but must be used on stands?

What are two light types that have a constant light output (not flash)?

Photographic umbrellas are used to do what? Soft boxes?



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10.1: 10PH ROCKS and TREES

For a long time I used a large camera that required a tripod. Often people would stop and ask the reason I was surveying. After explaining that the thing on the tripod was a camera, they would ask what I was taking a picture of (as if the location of the front of the camera was not a pretty good clue). They were really just striking up a conversation, but if I was in a snarky mood I would say rocks and trees.

Landscape photography has a long and varied history. Rocks and trees is a shortcut way of saying the environment we live in, whether it is unspoiled nature (is there really such thing now?) or nature combined with the results of human activity. There is no firm dividing line of what constitutes landscape, so here I stretch the term to mean any photographs not of people. Even architectural photography shares a lot of conventions with traditional landscapes.

Perhaps the most pivotal figure in landscape photography is **Ansel Adams**. His images are from an environmentalist's point of view, and they bridge the gap from commercial to creative. His photographs have been equally at home in the Museum on Modern Art or the cover of a magazine. For a long time I rejected his vision as being too sterile, but that is ignoring his contributions. **Todd Webb**, **Wynn Bullock**, and **George Tice** are other photographers who worked in the same vein as Adams. Of course, these photographers photographed many things, but their landscapes are incredible.



Ansel Adams (1977). The twist of his nose was a memento of the 1906 San Francisco Earthquake. He took pride in this injury from nature.

Frederick Sommer's landscapes can be wonderfully bizarre, and **Minor White's** are kind of Zen and abstract. Speaking of abstraction, **Ernst Haas**, **Aaron Siskind**, **Paul Caponigro**, **Ray Metzger**, and **Lennart Olson** made great abstract photographs (which is a bit of a contradiction in terms). And although it stretches the concept of landscape too far, in speaking about abstraction one has to mention **Ralph Gibson** and **Barbara Kasten**.

In the 1970s photographers began making new kinds of landscape photographs. Often called the New Topographics after an exhibit of that name which included photographs of **Lewis Baltz** and **Robert Adams**, these were 'cold' photographs which were detached from emotion and starkly shot. Both influencing and influenced by this style are the photographs of **Richard Misrach**, **Thomas Struth**, **Bob Thall**, **Joel Meyerowitz**, and **John Gossage**.

Landscapes also took other directions. **Linda Connor's** images hark back to 19th Century photographs, **John Pfahl's** images are playful, and **Mark Klett** combines images in expected and unexpected ways, and is also known for rephotographing famous

images from the past. **Andreas Gursky** uses subtle manipulations in his landscapes, while **Jerry Uelsmann** used obvious manipulations before there was Photoshop.

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11: History of Photography

To appreciate a medium such as photography, knowing a little bit about where it came from is essential. It is no different than the appreciation of a friend in this regard. Don’t you want to know what their life has been like thus far? This chapter is a very brief history of the beginnings of photography.

To make photographs, two things are needed: a camera and a way to make the images it projects permanent. The first of these requirements has been around for hundreds of years in the form of a camera obscura. This is a camera an artist could use to manually trace the projected image. In Latin, camera means room and obscura means dark. Makes sense.

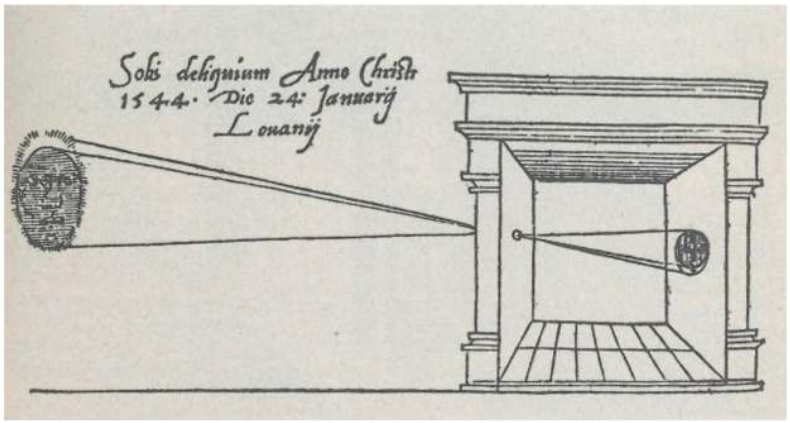
Photography (light writing in Greek) had to wait for a means to automatically secure the camera obscura image. It was known that silver compounds were sensitive to light, but getting them to form an image that wouldn’t go away when you looked at it under light was impossible.

Instead of silver, Joseph Nicéphore Niépce experimented with securing images using an asphalt that hardened with light. Although he did get images using this method, it was not a practical process—the images were faint and the exposure times, even in bright sun-light, were all day long. Niépce’s process was a dead end, and the invention of photography would have to wait for a better way of making automatic images.

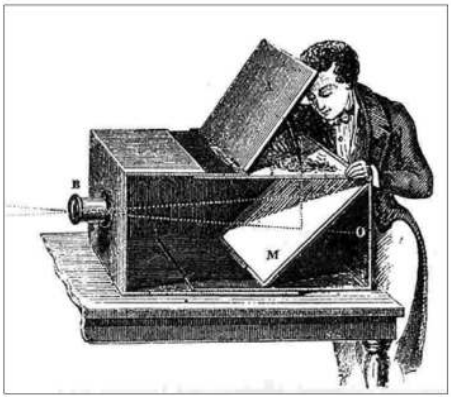
So, why mention him at all? First, an example of his process is the oldest photograph that still exists—taken over a decade before photography was invented. Secondly, his experiments sparked the interest of someone who would actually go on to invent a practical method for making photographs.



Joseph Nicéphore Niépce, 1826. View from his window (original is much lower contrast).



ABOVE Description of a camera obscura from 1544
BELOW Eighteenth Century camera obscura being used to trace an image. Light enters the lens and the image is reflected up by a mirror to project onto a piece of translucent glass.



Daguerreotype

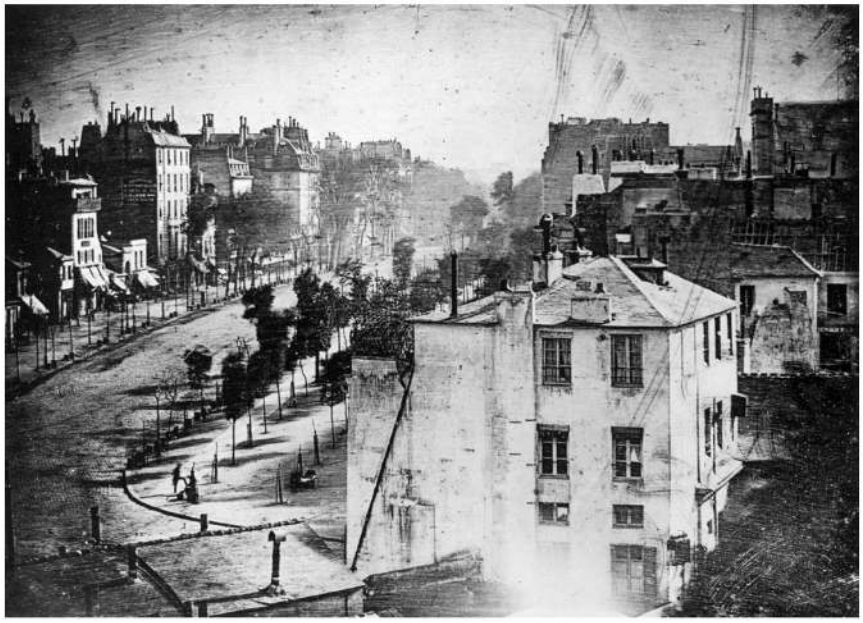
Louis Daguerre was an entertainer of sorts—he owned buildings, called dioramas, where people could view huge paintings of romantic (in the awe-inspiring sense) far-away places. These canvases were painted on both sides so that by changing louvers in the ceiling the scenes could appear to go from day to night.

Diorama paintings were expensive since realistic detail was needed to transport the audience into another time and place. So Daguerre contacted his fellow Frenchman Niépce to inquire about his process of automatically making images.

Somehow or other (the exact way is speculation), Daguerre came up with a process radically different than Niépce's. They both used metal plates, but Daguerre's were plated with silver, then sensitized with an acid that made the silver on the surface a silver compound. After an exposure in a camera obscura, the plate was then set over boiling mercury (no, that is not good for you) to make the image more visible.



RIGHT Daguerreotype of Louis-Jacques-Mande Daguerre taken by Jean-Baptiste Sabatier-Blot. They liked long names.
BELOW Daguerre's 1838 image of Boulevard du Temple. This is a busy street, but the exposure was too long to capture anyone but a shoe-shiner and his customer (lower left).



Daguerre sold his invention to the French government, who announced the Daguerreotype process free to the world (no patents) in 1839. Perhaps governments could do that today with important inventions...

Daguerre's 1839 invention of photography was not perfect. The silver plate that was in the camera was the one you took home with you, so to make a copy another photograph had to be made. Although improved later, the first Daguerreotypes required very long exposures and they were difficult to make, and therefore expensive, especially if they were large (bigger than an old flip-phone

screen). Since the image could be wiped away with a thumb, they had to be put in cases and covered with glass. And they were so reflective that often you had to hold the lid of the case in the right position to see the image.



RIGHT Daguerreotype in case.
BELOW The image reverses if the reflective surface of the image is reflecting lighter tones.



Hatters and Photographers

The mad hatter of Alice in Wonderland was not the only hatter who was mad—hat makers used mercury in the felting. Photographers also used mercury, boiling it under their noses.
It is a sad irony that many photographers became victims of mercury poisoning which not only crippled their minds and killed them, but also sometimes blinded them.

Even with their shortcomings, Daguerreotypes were extremely popular across the world, and you can still sometimes find them in antique markets. With photographs being so ubiquitous now, it is difficult to imagine how important Daguerreotypes were. To be able to hold an image of someone or something. Not the interpretation of a painter, but an actual reflection. The immediacy of this is still amazing. Look at a photograph of someone who has died, and there they are, getting a photograph made of themselves, looking out at the camera... but they are dead (this observation is from the book Camera Lucida by the philosopher Roland Barthes).

The Daguerreotype was a disrupting technology. Portrait painters worried that it would put them out of business, and for ones that specialized in inexpensive small likenesses, it did. But photography was unsatisfying in ways—a common complaint by someone having their photograph taken was that the result was far uglier than they were.

As with all new technologies, there was confusion as to what photography was and how it should be used. Many emulated painting—after all, the product was an image. But a nude photographed elicits a different reaction than a nude painted. It was like art, but there was no hand involved, so was it art?

The uses and purposes of photography unfolded over time, and as the technology of the Daguerreotype improved (shorter exposures, more controlled image quality), so did the ability of photographers to find the strengths of the medium.

Henry & Hippolyte

When Daguerre's discovery was announced, others claimed that they too had invented photography. Hippolyte Bayard in France and Henry Fox Talbot in Britain invented photographic processes so unlike Daguerre's that the differences serve as proof that they too had indeed invented photography.

Bayard's process used a silver compound (halide is a more precise term) embedded in paper to put into the camera. Talbot's process also used this method, but in his invention the paper produced a negative image. This negative image was then laid over another sheet of sensitive paper and exposed to make a positive image. So many prints could be made.

Talbot's process was patented. It produced somewhat fuzzy results, but wonderful images were made with it. His negative/positive approach foreshadowed later processes where many copies can be made from the original negative.



Robert Cornelius, 1839. This Daguerreotype self portrait may be the earliest example of portrait photography surviving. And the earliest 'selfy'.

Southworth & Hawes was a Boston photography firm that produced outstanding Daguerreotypes. Although they excelled at beautifully sensitive portraiture, they also photographed other scenes, such as an early operation using ether as anesthesia (at right). Photography was not the only invention that changed life at the time. Asleep under ether was a much better alternative to alcohol, opiates, and straps (although one could wish for those surgeons to wash their hands). The utilization of steam railroads was an almost magical alternative to the horse and wagon. It was a time of change.

Collodion

Ether was not only good for putting patients asleep —it was also used in forming a new type of surgical dressing. Gun cotton, a syrupy substance also called collodion, could be painted on wounds to seal them or hold down bandages. It is still sometimes used for this today.

In 1851 Frederick Scott Archer found that silver compounds could be mixed with collodion to make them stick to glass. This coated glass was put into a camera, exposed, then developed (bathed in chemicals to make the image appear). The resulting

negative (tones were reversed) was then laid over sensitized paper to form a positive image. The collodion process is also called wetplate since the glass had to be coated, then exposed and developed before the collodion mixture dried.



Albert Southworth and Josiah Hawes, 1847

Over time the collodion process completely replaced the Daguerreotype. It was easier, cheaper, and the print size was only limited to the camera size the glass plates would fit into. Also, very importantly, multiple prints could be made from one negative, solving a major shortcoming of the Daguerreotype.

For over thirty years collodion was how photography was defined. It is probable that you or your family have photographs taken with this process. The paper prints used egg whites instead of collodion to bind the silver to the paper. These albumin prints can be identified by their cheesy hue and fading. The thin prints are always mounted on a card or board.

There are two variants of the collodion process. The first is the tintype, where a direct positive was made in the camera on a black piece of metal coated with collodion.

Although these could not have multiple copies (since there was no negative), they could be made very cheaply, were durable, and many survive in excellent condition.

The collodion could also be coated on glass to make a direct positive called an ambrotype. These are often in cases like Daguerreotypes, but they do not have the mirror finish.



LEFT Anonymous cheese-colored albumin print. Originally the print was probably tonally rich with a purplish hue.
RIGHT Anonymous tintype. Notice the hand coloring of the cheeks. This hand coloring is also found in many Daguerreotypes (such as the one at the beginning of this chapter).

By the 1870s the collodion process was improved to the point that it was possible to develop the negatives after the collodion had dried in some situations, meaning photographers did not have always have to lug a darkroom around with them, but could process the image at their leisure.

Collodion changed photography from a craft in which skilled technicians produced expensive one-of-a-kind photographs to a medium that was accessible to many. Although it was still too difficult for most lay-persons to make collodion photographs, it democratized the medium enough that everyone on this side of poverty could have their own photographs of themselves, their loved ones, and famous people.

The collodion process also enabled photographers for the first time to bring images of many different aspects of life to a large audience.

War Photography

Even though he took few photographs of the United States Civil War, Matthew Brady is responsible for most images of the conflict. Here is how that works: Brady was a highly successful owner of photography studios with locations in multiple cities,

taking photographs of the rich and famous. The source for that portrait of Abraham Lincoln on the five dollar bill and the penny? —Brady.



TOP Alexander Gardner, 1862. Bodies on the battlefield at Antietam.
RIGHT Matthew Brady in 1875.

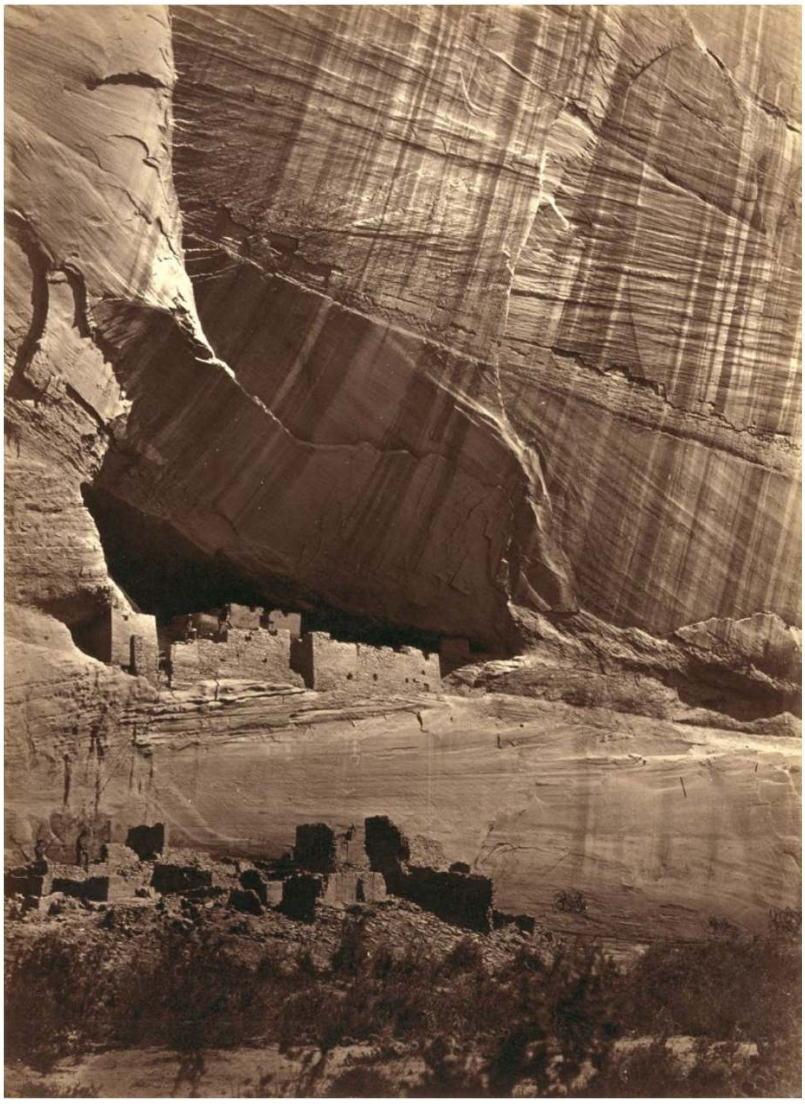


When the Civil War began, Brady saw it not only as his duty, but also as a business investment, to photograph this momentous occasion. He invested all of his fortune into hiring photographers to document the war as truthfully as they could. These photographers, including Alexander Gardner and Timothy O'Sullivan, could not take photographs of action (exposure times were measured in seconds), but they provided thousands of images which showed the conflict in unflinching terms. Today the surviving images form our view of what that war was like.

After the war, Brady's photographers went on to other things, as did the public. No one wanted to remember that horrible chapter in American history. Eventually the government did buy some of Brady's negatives, but it was too little and too late. Brady never got out of debt, and he died in a charity ward.

Travel Photography

After the war, one of Brady's photographers, Timothy O'Sullivan, traveled west with a government expedition. Distant places in the 19th Century were much less accessible than they are today, and most people only knew of the American West, the Middle East, and the Egyptian pyramids through written descriptions and unverifiable drawings.



Timothy O'Sullivan, 1873. White House ruins at Canyon de Chelly, Arizona.

Photography changed that, and O'Sullivan was one of many who brought proof of these places back home. Photographs could not be mass reproduced in publications at the time, but the published engravings were careful to note that they were drawn from photographs. Photographs themselves were mass printed for sale as portfolios (for the well-heeled) and as stereo (3D) cards for the middle class. A hand-held stereo viewer was must-have entertainment in a Victorian parlor.

Amateurs and Artists

Although photography was rarely put on the same plane as painting and sculpture in the Nineteenth Century, there were many photographers using it as an expressive medium.



Julia Margaret Cameron, 1864. The title of this image is Sadness. The model is the actress Ellen Terry.

Julia Margret Cameron was one of these photographers. To call her an amateur is somewhat misleading in today's terms. Before the Twentieth Century amateur did not have the negative connotations it has today. Indeed it was amateurs —people with incomes separate from their pursuits —who made many important contributions to science and art.

Cameron is sometimes derided as 'not very good at technique', but her technique fit her vision very well. Her photographs are straightforward and insightful. Because allegory (bigger truths revealed by symbolism) was seen as high art, many of Cameron's image titles are cringe-worthy today. But the portraits themselves are timeless.

O. G. Rejlander was a photographer who exhibited his work alongside paintings in exhibitions. His allegorical work was celebrated in part because he strove to over-come the prejudices of photography as a handless craft by highly manipulating the images. Despite the nudity in the photograph at right, a copy of it was bought by Queen Victoria for her husband. It is said that the left half was covered by a curtain when it was publicly displayed.

Rejlander was part of an informal circle of famous artists, writers, and scientists who all knew each other. The author Lewis Carroll (Charles Dodgson) was also part of that circle and was inspired to take up photography by Rejlander. The Alice of Carroll's Alice in Wonderland was Alice Liddell, a favorite friend of Dodgson's whom he photographed many times.

Scientific Photography

In 1872 Rejlander illustrated Darwin's The Expression of the Emotions of Man and Animals with his photographs. Photography was involved with the sciences both to illustrate and to inquire. One famous experiment sounds a little strange today, but is as interesting as it is important to the history of photography...

The question had to do with how a horse uses its legs at different gaits. Often paintings depicted horses running with all hooves off of the ground—front legs directly in front, back legs directly in back. But did they really run like that? It is impossible to tell by just observing them since those legs move so darned fast.



O. G. Rejlander, 1857. The Two Ways of Life was an allegory with a moral purpose.
Combining 35 separate images, Rejlander depicts how a young man can go into a world of sin represented by the groups of figures on the left. Instead, the young man can proceed into a life of virtue represented by the figures on the right.

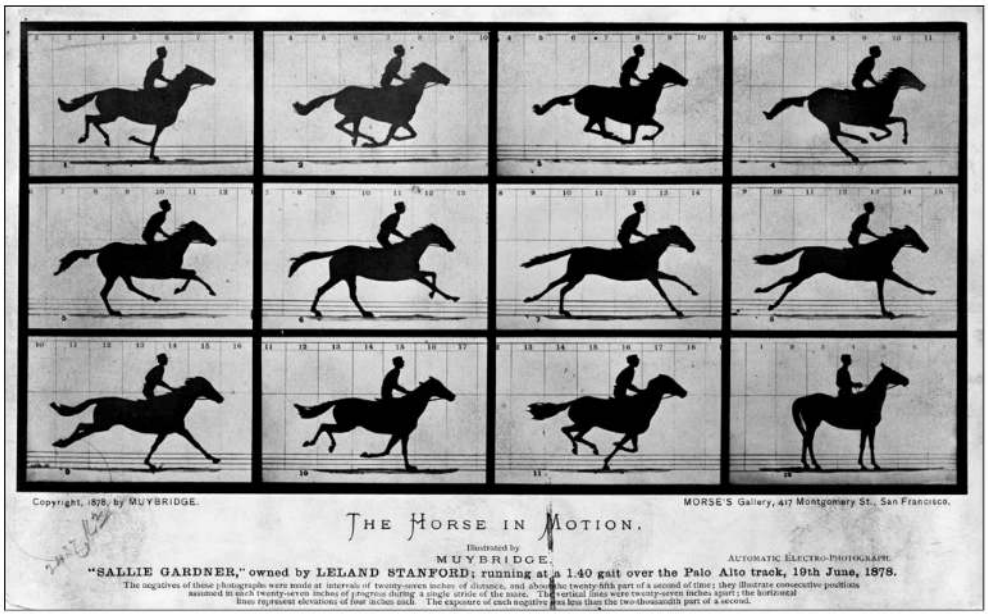
Edward Muybridge was a photographer mostly known for his landscapes of the American West, but he was also an inventor who was capable of pushing the limits of photography and the camera. Because of this, he was hired to settle a dispute over the running style of horses.

Muybridge set up 12 cameras along a track. With each camera, a thread strung across the track tripped the shutter. The result was proof of the running style of a horse. But it turned out to be more. Muybridge noticed that if you saw each image quickly in succession, the horse appeared to be moving. Muybridge's device for viewing the images in this way is a zoopraxiscope. Although not practical except as a curiosity, this was part of the beginnings of motion pictures.

Muybridge continued to do motion studies with both human and animal models. These studies were used by scientists and artists to understand how humans and animals move.

Really?

If you like undeserved rumor, intrigue, and titillation with your photography, read more about Lewis Carroll and Edward Muybridge.



Edward Muybridge, 1878. Because exposure times would have been too slow otherwise, the photographs are underexposed to the point that only the silhouette of the horse is discernible.

Socially Responsible Photography

Towards the end of the Nineteenth Century the plight of others became a concern. Everything from disappearing native societies to child labor was photographed and introduced into evidence that demanded action and sometimes changed laws.

Jacob Riis photographed the plight of the poor in New York City. As a police reporter in the slums, he knew them well, and was determined to help those who lived in poverty. He used his photographs of the poor first in a series of lectures he gave, then in books, the most famous being How the Other Half Lives.

It is hard to overestimate the influence of Riis and his photographs. Not only in his own city, but in other cities that saw themselves mirrored in his reportage. Using photographs to reveal the hardships of others was later done by the US government to document living conditions during the Depression. Photography is still a powerful force for change today.



Jacob Riis, 1888. Lodgers in a crowded Bayard Street tenement.

Portraiture

Of all of the uses of photography in the Nineteenth Century, portraiture is paramount. Humans love pictures of themselves and of other humans. Its just the way it is. Oh, and cats too nowadays.

The most popular form that collodion portraits took were small cards upon which the portraits were mounted. These were called cartes de visite, which translated from French is visiting cards. Often visitors would leave a calling card (like today's business card) when they visited. Cartes de visite were the photographic equivalent. Although not important as calling cards, they were the primary way to have a photograph of someone. Like a class picture in school. Trade them, collect them, put them in albums. These were inexpensive enough for any amount of disposable income, and you could come out of the photographer's studio with several versions. Very much like today's portraits.

Also called card photographs, these cartes de visite are plentiful leftovers from more than a century ago, and can be readily found in drawers, attics, and flea markets. If you happen to find a family album with someone famous or infamous in it, don't get too excited or alarmed. Your great-grandfather probably didn't know the queen, but could buy a carte de visite of her for a few pennies.

Later card photographs are a little bigger than cartes de visite, and are called cabinet photographs.



LEFT Front and back of typical carte de visite. These were not high art, but cheap keepsakes.
ABOVE Carte de visite of Sojourner Truth. Copies of these were sold to raise money (see caption). This was at a time when photographic reproduction in publications was not technically possible.

Gelatin

Besides making Jello-like desserts, it was found that gelatin made a very good alternative to collodion in photography. By the late 1870s photographers could buy their plates (the glass with the light sensitive coating) ready-made. This was surely an improvement, but an incremental one.

The real breakthrough in photography was in 1888, when a plate manufacturer, George Eastman, bought a Wisconsin farmer's patents and came out with a totally new way of taking photographs. He coated a long strip of paper with the gelatin and silver mixture, then rolled it up and put it in a very simple camera with a fixed shutter speed, aperture, and focus.

All the photographer had to do was aim the camera in the general direction of the subject, then push the button. A lot like a cellphone camera.

After a hundred photographs filled the roll of film, the photographer sent the camera back to Kodak, the name of Eastman's new company. Kodak would then send the photographs back as prints and the camera reloaded with a new roll of film ready to shoot more images.

With a Kodak camera anyone could be a photographer and the snapshot was born. People started grinning for the camera, and casual parts of life were recorded. It was a new way of looking at the world.

Photographic processes changed rapidly around the turn of the century. The paper backing Eastman used was replaced by a type of clear flexible film. Gelatin, which had many advantages over albumen as well as collodion, also became the common print emulsion (the mixture which holds the silver in suspension). These prints retain their tonality much better over time and are more neutral in color.



Early gelatin snapshot. A woman with a dog, three cats and a bird in a wheelbarrow (you wouldn't smile much either).
At the bottom right you can see a reflection from silvering, a common sign of aging with gelatin prints, especially earlier ones.

Twentieth Century

Excuse the brevity, but actually the entire Twentieth Century was a bit of a watershed in the technique of photography. Cameras became more precise and generally smaller over time with more automation towards the end of the century. Kodak, with its impressive start, dominated the market of photography supplies. Film became somewhat more sensitive to light, and instant photographs became an option in the late 1940s with Edwin Land's invention of the Polaroid camera.

Color photography, which had been around since the 1860s, became practical, and then more practical, and by the 1950s and 1960s becomes the norm. Movies progressed as well, quickly gaining sound and then color.

All of this is not to say that photography stood still aesthetically or conceptually in the 20th Century. As a matter of fact, that evolution is far more interesting but beyond the limits of this text as there is no concise story. Find the story yourself. You have

names and places to start with in the sections of this text dealing with photographers. It is a rich subject with many curves and surprises as it weaves around other media.




Images from an Apple QuickTake 100 camera (1994). The downsides of the camera were that the images were of poor quality (and 0.3 megapixel), the camera could only take 8 images before an excruciatingly long download to the computer, and the price was $750. The upside was that it was a digital camera.

Twenty-First Century

Digital photography has been around since 1975 and perhaps even before (depending on how you define digital). The first digital camera as we know it today was available in 1990, and what many recognize as the first digital consumer camera was offered by Apple in 1994.

But it was around the turn of the century when digital technology became an inexpensive alternative to film. Kodak, which had a great run for over a hundred years, filed for bankruptcy in 2012. This signaled the relegation of film photography to an archaic process. One that still has uses, but is not the mainstream technology of photography.

This brings us to today, when virtually all photography is done digitally. The cellphone has replaced the Kodak, and digital cameras have replaced the 35mm camera. The use of photographs has grown into a part of daily communication.

History Questions

Which came first: the camera obscura or photography?

Who invented photography?

When was photography invented (approximately)?

What photographic process produces very reflective images?

What photographic process replaced the Daguerreotype?

What is the collodion process also called?

What print process used egg whites?

Who is responsible for many Civil War photographs?

What famous book author was also a very good amateur photographer?

What photographer was instrumental in developing motion pictures?

Who used photographs to show how the poor lived?

What is a common 19th Century photograph mounted on a card called?

What substance replaced collodion in the late 19th Century?

Who started the Kodak Company?

What company dominated photographic supplies during the 20th Century?



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11.1: 11PH PAST PHOTOGRAPHERS

One of my favorite photographers is Julia Margaret Cameron. Likely it is because she does things in her photographs I could never do. If I tried to emulate her romanticism, it would come out cheap and tawdry—heck, I even think some of her images are cheap and tawdry. But beautifully so.

Anyone interested in any pursuit is going to be concerned with how others have approached that pursuit. As you learn about photographers, you will see that they are no different. They learn from what others have done, whether it is an approach from yesterday or from over a hundred years ago. Styles and approaches change, but that indefinable quality of good somehow runs irrespective of style. As humans we respond (or we don't).

As one gets to know how photographic images work, there is a communication with those who have come before. Through looking at photographs you feel a bond with the photographer—you can see into the corners of what they are doing, you can feel them.

So, I look at Cameron's images. On the surface are the conventions of the age—a Victorian way of dressing and heroic poses. But beyond that is something deeper, but impossible to explain. A close connection between us that bridges more than a hundred and fifty years.



This is one of a series of images photographed with a flatbed scanner before digital cameras and printed on an early ink-jet printer. These were an homage to (copy of?) the very beginnings of photography, as digital was a rebirth of those beginnings. As such, they were simple, somewhat scientific , and had a raw feel. Much like a photograph from 1840. Digital Talbots.
Sometimes concepts don't work. I still love the images, but I rarely get anyone to agree with me on this.

There is a myth about creativity—we celebrate those who find new solutions, who come up with new things. But in reality, there is nothing new under the sun. Styles change, we combine things to come up with something new. The past is a lot closer than we think. This is true in any medium—we are copiers, we can spit out only what we know. For example, you may think that some singer or band is totally new. But they are instead building upon what others have done. Imagine someone who has never heard a song coming up with one. What kind of song would they come up with? Surely not what they came up with after a lifetime of listening to songs!

Take tours through the past. See what hits you, what makes you respond. If you like something, follow the path that it presents. Find some heroes. Looking at what others have done teaches you far more than you might think, and influences what you do in a multitude of ways.

Of course anything that was done yesterday is history, but some good resources that go back farther include the **Victoria and Albert Museum**, which is easy to navigate with thumbnails; the **Eastman Museum**, which includes not only many photographers, but also a lot of technical things; and the **Science + Media Museum**, which has not only the canon of photography, but also some intriguing things off of that path. Once you get to know some of the ins and outs of the history, you can do searches at some

excellent image repositories such as the **Digital Public Library of America**, which is full of images culled from other sources; the **Getty Museum**; the **New York Public Library**; and of course the **Library of Congress**, which is difficult to navigate, but very rich. There are also other sites which deal with the history of photography—**Photogrammer** lets you search for images from the **Farm Security Administration** by location on a map (find your home town!).

Some early 20th Century photographers are recognized to have shifted the direction of the medium. These include **Alfred Stieglitz**, who not only made images, but published and exhibited the work of other photographers such as **Paul Strand** and **Edward Steichen**. **Steichen** was also very influential as the first director of the photography collections at the **Museum of Modern Art** (MOMA later went on to become an outsized influence on how the art of photography was defined).

Gertrude Kasebier's dreamy and fuzzy images are some of the best examples of Pictorialism, a turn-of-the-century style which used the camera as an instrument of feeling instead of fact. **Man Ray's** and **Andre Kertesz's** photographs epitomize the exuberant experimentation of the Surrealist movement, and **Bill Brandt** picked up about where they left off.

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12: Color

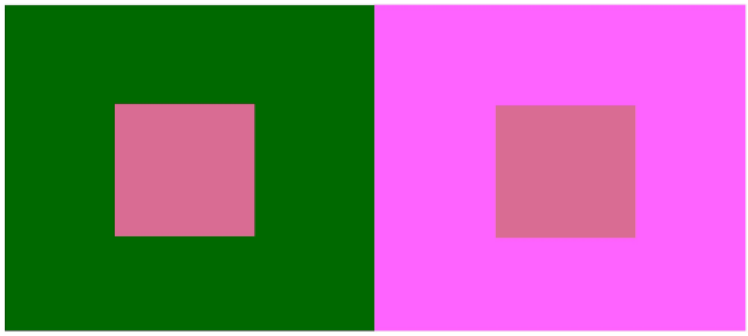
Color on the computer is a complicated subject, but there are some fairly simple things that you can do to ensure that your color is predictable and consistent from your camera to your printer and across computers that are used to view your images. You might not use all of the information in this chapter, but it will give you a good framework for understanding color issues.

Color is a much more slippery thing than you might think. Consider the perception of color. Just like smell or taste, sensitivity to a color diminishes the longer one is exposed to it. Adjacent colors also change the perception of a color. In short, a human's physical structure (and also memory) is fairly poor with color, and that is not even considering various color blindnesses that affect around one in ten males.

Making this problem worse is the fact that color on a computer is greatly influenced by the color and brightness of the light in the environment of the computer. Proof of this can be had by looking at a camera or phone display in bright sunlight.

Although computer displays have improved, each one also has different color, and the color capabilities of different devices (cameras, computers, and printers) can vary widely. Blue is always blue, but there can be astounding differences in what kind of blue is displayed. A television's colors even change greatly between the different standard viewing settings.

To understand how to control what by now should appear to be a mess, first some background on how color is made, something that was briefly covered in the Sensor chapter.



It is difficult to tell if the squares in the middle are the same color and tonality because of the surrounding color (they are the same).



Bryan McCarty

Additive Color

As we have seen, cameras and computers record and display only three colors: Red, Green, and Blue (RGB). These individual colors are too small to see individually, so effectively they are mixed to show the rest of the colors (see illustrations at right). These three colors are the additive colors, since the screen or camera image starts out black and the three colors are added to show or produce an image. These colors are different than the primary colors you might have learned in an art class.

Each of these three colors is divided into 256 levels of brightness, and varying these brightnesses can make any color the camera or screen is capable of.

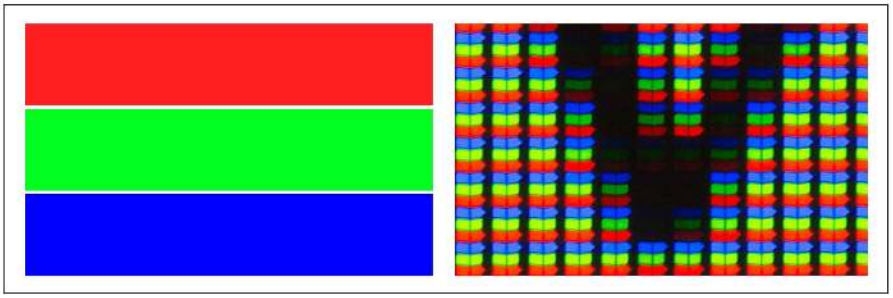
Color Space

But here is a rub: What exact color should be displayed when the definition is something like [Red: 255, Green: 150, Blue: 0]? These are not numbers that occur in nature, so there has to be a language to define them.

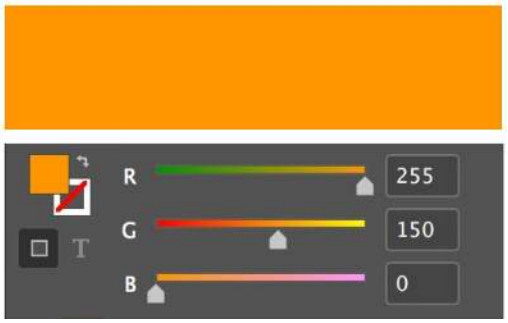
The most common language for these numbers in photography is called sRGB, a language codified by Microsoft. It is the default both on your camera and on your computer. It is called the color space in which you are working. Most likely you have seen sRGB in passing. Sometimes it is shown with a string of numbers after it.

When you take a picture, a little notation is added to it which says the image colors are defined by sRGB. The computer reads this notation, and displays the image using the sRGB language (color space). So that kind of violet purplish medium dark color is displayed correctly.

When you make a print, the printer sees that the image is defined by sRGB, and adjusts accordingly.



LEFT The red, green, and blue used by cameras and display screens.
RIGHT Close up of a screen with the bottom of letter on a white background. Notice that the white cannot be perceived this close. At normal viewing distance the individual colors are mixed to our eyes.



An orange and its definition below. Some ranges show these as percentages rather than the 0–255 scale. Three sliders are all that is needed to make any color the computer is capable of displaying.

Adobe RGB

There is another color space that your camera is probably capable of using, and since it was developed by Adobe, it iscalled Adobe RGB. Many photographers use this color space since it is capable of more print colors than sRGB. So, to get this wider range of colors, you set your camera to Adobe RGB (1998 may be included in the name).



Adobe RGB is actually good for screen display also, but be careful. Many web browsers and email programs (especially those with Microsoft operating systems) default to sRGB and do not do the translation necessary to produce good color. In this case your images will suddenly look too dark. But you can always easily convert an Adobe RGB image to sRGB when it is destined for the screen (usually for web or email use).

There is one more color space that you might come across called ProPhoto RGB. This is a newer color space that is capable of even more colors (called wider gamut) than Adobe RGB. In many workflows Adobe applications will default to converting images to this color space as you work on the image.

Whatever color spaces you use (usually sRGB if you do nothing), make sure that you use them appropriately and that the camera, application, and printer all agree on the color space.

Three Part Color

There are many ways of describing colors, but to describe colors from a full spectrum there are always three parts. So, you can describe a color with a numbers for Red, Green, and Blue. CMYK is also a three-parter, since K (blacK) is not used to describe the color but as a technical fix for printer inks.

There is also HSB color, in which numbers are assigned to Hue, Saturation, and Brightness (this is sometimes very useful); and Lab color where the first number is assigned to Lightness and the others to color ‘a’ and color ‘b’. And there are many more—always with three things to describe the color.

If you ever see a color space visualized, it will also be in three dimensions. On Macs you can go to Applications> Utilities> ColorSync Utility and choose one of the spaces on your computer. It takes the form of a multicolor block which you rotate to see all three dimensions.

Subtractive Color

All printers (from a home inkjet to a commercial printing press) use a different set of colors to make color. These are Cyan, Magenta, and Yellow. (CMY). Black is added to this mix to compensate for ink characteristics, so the colors are CMYK (poor black has to be K since Blue took its initial) These are the subtractive colors, called such because the paper (or other medium) starts out white and light is subtracted to show or produce an image. In other words, all the subtractive colors will produce black, where all the color in the additive system will produce white.

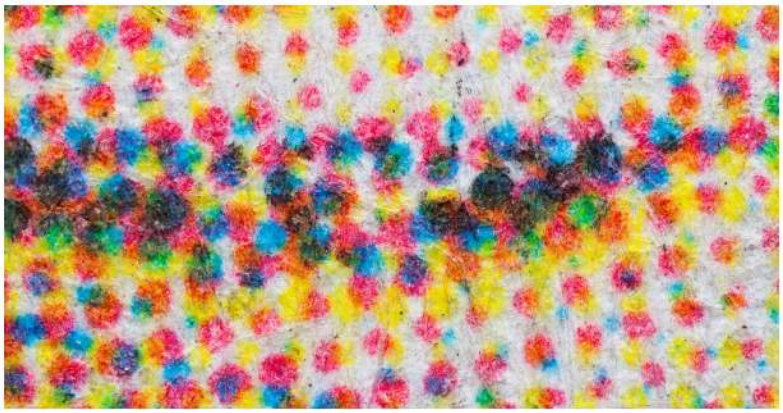
This doesn’t mean you should specify CMYK color when you print—ink jet printers expect to do their own conversion from RGB, and printing an image that is in CMYK may lead to incorrect color.

If you are including photographs in a publication, many commercial printing firms will ask you to convert all of your images to CMYK in an image editing program. Don’t do this without specific instructions on how to convert them. There are a lot of options,

and without knowing the specific CMYK color setup the printer needs, you will probably get unpredictable color. Ask your printer for instructions!



A portion of Photoshop's CMYK conversion options.

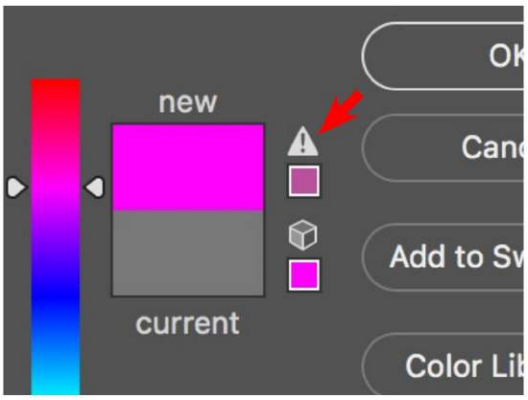

Subtractive (CMYK) color. Close-up of printed smile from a newspaper. Although the only colors used are CMYK, the green results from the transparency of the yellow ink laying over cyan ink. All printed digital photographs look something like this when highly magnified.


CMYK: Cyan, Magenta, Yellow, and Black

Color Gamut

The range of colors that can be produced with any device (such as a camera, monitor, or printer) is called the color gamut. Every device has a different gamut, with prints having a much different gamut than screen images. For example, no printer will be able to print a saturated green that the monitor displays—instead it will just print a less saturated version. That color is just not possible mixing CMYK inks.

Most photo applications will alert you when you try to pick an out-of-gamut color. The best thing to keep in mind is that this might be why your print doesn't match your screen image. The gamut of most displays are pretty close to each other, but you might also see differences between a computer and a phone.



The exclamation mark next to the new color indicates an out-of-gamut color for printing.



Clicking on the exclamation mark will select the closest in-gamut color. This illustration is from Photoshop.



The Apple Display Calibrator takes you through easy steps to make a profile specific to your display.

More Control

As mentioned, color from the camera to the computer to the print or to other computers is controlled fairly automatically. If you want more control, there are several things you can do.

Computer displays are each a bit different in how they display color, and even changes in the light existing in a room can make a display appear differently. One of the things you can do to correct for this is found in the Apple System Preferences under Displays. Clicking the Color button will allow you to calibrate your display to make it more standard to other computer displays. This is a somewhat subjective process, but if you don't get it right, you can easily go back to the standard setting.

Another thing you can do is make sure you always use the same lighting environment when you edit photographs. A room only lit with daylight-balanced lighting is ideal, but it is really like eating veggies you don't like. Who wants to sit in a consistently lit room all day unless they are paid to?

At the very least you can be cognizant of the brightness of your computer display, the room you are in, and the light you use to view photographic prints. So, don't sit in a dark room with your display at maximum brightness. Even with the help of assessing the levels, the image will be too dark to just about anyone else looking at it in a different viewing environment.

Better Computer Display Color

While the Apple calibration is somewhat subjective (you adjust it by viewing targets), several manufacturers make color calibration devices which cost a few hundred dollars. These automatically calibrate not only your display, but many can also calibrate your printer to make it more of an ideal 'standard'. I have found these to be essential in setting up more than one printer so they give consistent color. They are very easy to use.

Even with display calibration I can never get the two displays I use to completely agree. But the calibrator does help.



White Balance

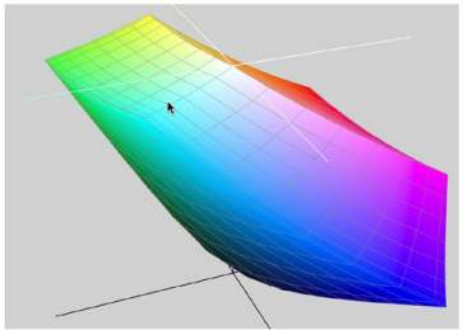
When taking photographs, you can make color easier to deal with when you are in a stable lighting situation and have a little extra time. Take a sheet of paper and put it somewhere in the scene for one shot. When you are editing your image you can use the white balance tool (in all image editing applications) to target that paper to neutral and your other colors will fall into place. Applying the same white balance to all the photographs you take under that lighting will also balance their colors.

For more precision you can buy a neutral gray card that has more neutral color than a sheet of paper.

Color Profile

Remember a color space is the definition of the way the colors are assigned to numbers. But since each device (such as a camera or printer) handles color differently, wouldn't it be nice to have another definition for how each device handles color? It would, and it is called the color profile.

If you adjusted your display as discussed earlier, you were actually making a color profile that defined how your specific display responds to color. And it enabled you to use that profile or the generic one that came with the computer.



A color profile 3D representation in two dimensions. Not practically helpful, but shows what one visualized looks like.

Ink jet printers work the same way. When you choose a printing paper, the printer invisibly uses a color profile for that printer/paper combination.

Since color profiles are largely invisible, it is only important to know that they exist and are there if you need to modify them.

Camera Color

Different cameras produce different colors. In part this is because manufacturers have different ideas about what constitutes good color. So you might find a photographer who likes the color output of Sony cameras, while another is partial to the color of Nikon cameras. Remember, photographs are not reality, but an interpretation of it.

These color differences can be dramatic—cheaper cameras can wildly oversaturate some colors, in particular red. You may have even noticed that in your camera's menu there are provisions for selecting the kind of color you want. Generally these should be

left at the most neutral setting. Choosing the color rendition later gives more control (these settings only apply to JPEG images anyway).

Critical Camera Color

For one step more control than with a gray card, you can buy a color checker which not only has a neutral gray area but a full range of colors that can be used to assess and correct image color. This is rarely necessary unless you are taking photographs of things which are very color-critical.

These can even be used to set up a camera color profile for a specific light source and camera which can then be applied in your image editing program. This allows for precise color control over not just gray, but many colors.



Image editing applications also have controls for correcting the colors of different cameras. These controls are useful when color is critical or when you need to correct the color of a camera that has very screwy color. I use these controls for images from my first DSLR. The color rendition of that camera can only be described as ugh. The color rendition of digital cameras has gotten much better over the years.

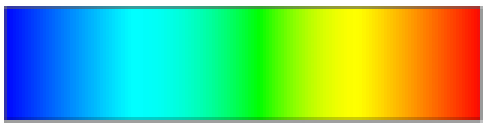
Light Color

Light is composed of a spectrum of different colors. For instance, the sun's light is white, but that white light is made up of all the visible colors (and then some). So, when you have a green plant, that plant reflects only the green part of the color spectrum. The sky is blue because the water vapor in the atmosphere predominantly reflects blue light.

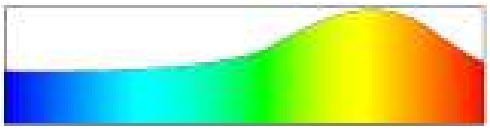
Many indoor lights emit different colors, but not quite the same way as the sun does. As already noted, incandescent lights emit more yellowish light, but this is not really a problem since the camera can balance the color to compensate for that heaviness.

LED lights and (especially) florescent lights may have a very uneven distribution of colors, and this can easily distort the colors in a scene. Because of this, these lights have a Color Rating Index (CRI) number which describes how close they come to emitting all

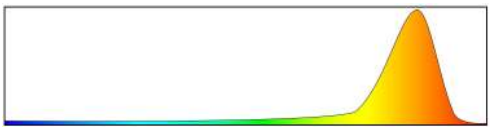
colors as the sun does (the full spectrum). A CRI of 100 would be perfect, but in practice a CRI of 85 is pretty good for lights that are used to take photographs or even lights used to choose the color of your outfit.



Very simplified representation of the colors in light. Sunlight has all the colors of the spectrum in even amounts. Flash is very similar.



Incandescent lights are heavy in the yellowish areas, but still contain all the colors of the spectrum in healthy amounts.



These are the colors contained in light from an orangish streetlight. This light cannot show colors because it is made up of only one color. Blue cannot be reflected if there is no blue in the light (see illustrations on next page).

Color Rating Index

Many quality household LED and florescent bulbs state the CRI on the package (or on their web site). This is because most people find that the most pleasant light to live with contains the most colors. Incandescent bulbs are not rated because by their nature they are all a CRI of 100 (the best).

If you have ever replaced an incandescent bulb with a florescent bulb and then decided the florescent light made the room look like a flop-house, then you should pay attention to the CRI for your household lights. Look for a CRI of 80 or above.

Kelvin temperature is also on the package, and is even more important. You don't want to be one of those people who put a 5200K (daylight) bulb in their living room fixture giving the room a warehouse look.

On a related note, look for the light output in lumen relative to energy. With LEDs, 1 watt per 100 lumen is a worthy target.

If you are in a situation where you don't know the CRI of a bulb, just take photographs anyway. Color errors are masked by many different factors, and even with low CRI numbers your color will probably look pretty good.

Lights especially made for photography will always have a high CRI and it will be stated in descriptions of them. Often the CRI of these is at least 90.

There are many other kinds of light sources, and some emit very uneven spectrums. Probably the worst common kind are the orangish lamps now being replaced by LEDs in streetlights. As you can see from the illustrations at right, they are not good for color photography!



Eva Murguet. Here color is used expressively. Correct color is sometimes just not important.



LEFT The color checker (patches of different colors) is photographed using incandescent light.
MIDDLE The color checker is photographed using a sodium light. This is the kind of light used in the orangish streetlights.
RIGHT The middle color checker is white balanced to the gray squares.
The sodium bulb only emits a narrow range of color, so the color patches appear without color. If there is no red (or blue or whatever) in the light to begin with, there is no red (or blue or whatever) to reflect from the color checker.

Color Questions

What are the only three colors a computer (or television) can display?

What is the term for the set of colors that make white when added together? The colors that make black?

How many levels of brightness does each color on a computer display usually have?

What defines the numeric description of colors?

What color space is most commonly used?

What color space is best for printing?

For printing the best quality images on an ink-jet printer, should you use RGB or CMYK mode?

What is the term for the range of colors a device can produce?

Why should you not edit images in a dark room with your computer display at maximum brightness?

What is card you photograph for precise white balancing called?

What is the definition of the color of a specific device, such as a computer display?

How many colors are there in sunlight? (trick question)

What describes how close a light comes to emitting the full spectrum of colors with fluorescent or LED lights?



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12.1: 12PH THE DEATH OF PHOTOGRAPHY



Whenever two or more old coots with cameras get together, the subject naturally turns to the death of photography. Things just are not how they were. People don't look at photographs anymore, they just scan over them. Digital photography is too easy. The only true photography is with film.

Actually, people said the same things about painting when photography was invented. So it serves us photographers right now that we have the disrupted technology. And painting was not dead after all.

Photography is changing. I myself have much useless information in my head, and can quote you the formula for D-76, which was a developer (chemical solution) for film (stuff you used to put into cameras). And I can tell you about… Never mind, as I said it is useless information. So, I am marginalized to some extent. Gone are the days of big cameras and the alchemy that proved I knew what I was doing.

Photography has not only changed technically, but also in the way we consume it. That thumb flipping through [insert favorite social media app here], barely giving a second for each image we see. Photographs are an integral part of how we communicate with each other now. And we perceive them in a way that is different than in the last century.

So, photography is not dead, but it is becoming something it was not. Personally, I don't know the ramifications of that change or even how I should deal with it. This isn't a negative thing, but a pretty cool thing. We don't know what is going to happen—the door is open for experimentation and surprises.

So far, most of these experiments are (of course) deadends. JenniCam (Jennifer Ringley) was a site with a web cam pointed to everything Jenni did, day and night. Seems a little perverse now (it didn't then), so I guess that is why it didn't last. I used to follow a blog of a woman who photographed herself jumping in different settings. Then it just disappeared. **Things Organized Neatly** is a blog by different photographers. **Photoshop Tennis** (modify an image and pass it on) is pretty low art, but it has stuck around. And apparently, there is also still room for photography as it was. **Tumblr** and **Flickr** both left out an 'e' and are full of new and old photographs repurposed for thumb-flicking.

There are things that are new and exciting that have happened after the turn of this century. I just saw an exhibit by **Viviane Sassen**, whose conceptual work left me high and dry, but whose images were incredible in their playful (?) handing of darks and lights. **Miru Kim** takes nude self portraits of herself in different situations. **Michael Wolf** is best known for his buildings which are reduced to patterns, while **Edward Burtynsky** reduces earth modifications to abstracts. **Matthew Christopher's** photographs are of abandoned buildings.

Matt Stuart continues the tradition of street photography, while **Doug DuBois** continues a tradition in narrative portraits, **Christopher Payne** continues a tradition in architectural photography and **Alexander Gronsky** continues the tradition of

landscape with his photographs of the outskirts of Moscow. **Martin Parr's** photographs are almost surreal in their humor and **Mark Nixon** is most well known for his series of teddy bear photographs titled Much Loved.

Theatrically staged photographs such as those by **Jeff Wall** and **Gregory Crewdson** have become noticed after the turn of the century. Women such as **Ilona Szwarc** and A**ndi Schreiber** have taken photographs exploring women's identity. And **Brandon Stanton** has a well-known series of photographs titled Humans of New York.

There are other newer pursuits in photography that defy categorization, like the images of **9-Eyes** (Jon Rafman) that are culled from Google Street Photographs, and sites like **Craigs List Mirrors** (Eric Oglander) that put together mostly anonymous images culled from the web.

As I wrap up these 'essays' about photography and photographers, what bothers me most is not how many photographers I have included, but how many I have excluded. How could I leave out **Irving Penn**, one of the best known photographers? Or **Tina Modotti**, whose history is as interesting as her photographs? And the playfulness of **Kenneth Josephson**? Or **Neal Slavin**, a photographer who forced the young me to think about how I was photographing? I have to stop now, because ending this name-dropping is difficult indeed.

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Index

G

graduated filter

6.2: 6CR MORE LOCAL ADJUSTMENTS

S

street photography

6.1: 6PH ON THE STREETS

Glossary

Sample Word 1 | Sample Definition 1

Appendix

Contents

TERM REFERENCES 256

SUGGESTED PROJECTS 258

PANORAMA & HDR 270

ANIMATED GIFS 271

OTHER TECHNIQUES 272

PHOTOSHOP TECHNIQUES 274

COPYING FLAT MATERIAL 279

CELLPHONE CAMERAS 282

LIGHTROOM INSTRUCTIONS 285

CREDITS AND OTHER THINGS 314

*Page numbers noted are where the term is defined. Multiple pages signify increasingly complete definitions.

8 bit image 80
24 bit image 81

A

additive color 243
Adobe Photoshop format 132
Adobe RGB 244
albumin prints 228
ambient light 213
ambrotype 228
animated GIF 192
A or Av (Aperture or Aperture Value) 148
aperture 44, 142
auto-bracketing 124
auto-focus 62
automatic ISO 89
auto setting 23

B

background light 211
battery 43
bit depth 80
bracketing 124
built in flash 213
Bulb (B) 162

C

cabinet photograph 235
camera 38

camera color 248
camera flash 213
camera movement 165
camera obscura 223
camera shake 165
card photographs 235
cartes de visite 234
center-weighted metering 125
channel 81
CMYK 244
collodion 227
color gamut 245
color of light 207
color profile 247
Color Rating Index (CRI) 249
color space 243
color temperature 84
complex lens 60
compression 131
copy stand 213

D

Daguerreotype 225
depth of field 57, 146
Digital Negative (.DNG) 86
Digital Single Lens Reflex 38
Digital SLR (DSLR) 38
digital zoom 109
diopter adjustment 23
direction of light source 203

E

Edward Muybridge 233
effective size of light source 201
evaluative metering 125
EV corrections 123
exposure compensation 123
exposure meter 125
Exposure Value (EV), 123

F

fast lens 66, 152
field of view 101
fill light 211
film 236
fish-eye lens 66
flair 67
flash 191
fluorescent 84
focal length 101

focus 44
focus areas 63
format 25
f-stop 142
full-frame equivalent 108
full-frame sensor 40, 82
function menu 22

G

gaffer tape 216
gelatin 235
George Eastman 236
gray card 247

H

hair light 211
hard light 201
highlight clipping 121
Highlights 120
histogram 119
hot light 214
HUH 42

I

image stabilization (IS) 60
incandescent 84
infinity 65, 150
initializing 25
ISO 24, 185
ISO setting 44
ISO speed 87

J

Jacob Riis 234
JPEG 131
Julia Margret Cameron 231

K

Kelvin 84
Kodak 236

L

LED lights 215
lens hood 67
level 78, 119
Lewis Carroll 232
light color 249
light falloff 210
lock focus 62
long lens 101
lost highlights 120

M

Macro lenses 66
main light 211
manual focus 63
Matthew Brady 229
maximum aperture 150
megapixel 79
memory card 25
midtones 120
mirrorless camera 39
mixed light 207
M (Manual) mode 187
monolights 214
motion blur 164

N

natural light 213
neutral gray 122
noise 82, 87
normal focal length 101
number of light sources 206

O

O. G. Rejlander 232
one inch sensor 82
open up 144
overexposure 120

P

panning 168
panorama 192
partial metering 125
PASM dial 23
photography 223
pinhole camera 56
pinhole lens 54
pixel 78
plane of focus 143
portraits 210
P (Program) mode 23, 170
prime lens 109, 151
ProPhoto RGB 244

Q

quick menu 22

R

RAW format 23, 85, 129
RAW+JPEG 24, 130
reflections 203, 208

relative movement 166
resolution 131
RGB 79, 243

S

SD card 25
sensor 26, 38, 78
sensor size 82
sensor size and focal length 106
shadow clipping 121
shadows 120
short lens 102
shutter 162
shutter speed 44, 162
simple lens 59
soft box 215
soft light 202
S or TV (Shutter speed or Time Value) 169
spot metering 125
sRGB 243
stop 88, 123, 162
stop down 144
subject movement 166
subtractive color 244

T

telephoto 26, 101
telephoto zoom 104
texture 202
Timothy O'Sullivan 230
tint 85
tintype 228
tripod 42

U

umbrella 215
underexposure 120
unusual light 190
UV filter 41

V

variable focal length lens 102
variables of light 201
Vibration Reduction (VR) 60

W

wet-plate 227
white balance 83, 247
wide angle 25, 102
wide angle zoom 104

Z

zoom lens 102
zoom position 25
zoom range 103

SUGGESTED PROJECTS

The following projects are some that have been useful to students in my photography classes. These projects are very flexible, enabling the student to bring their own interpretations into the mix. They also highlight key aesthetic controls that are used by photographers. As mentioned in the introduction, it is important that you make prints of a carefully edited selection of your photographs.

Preliminaries

This is a simple one. Just go out and take photographs! Familiarize yourself with the work-flow: Try different things with your camera, then file your images on the computer. Edit for your best images and then make some changes to those images.

The Edge and the Light

The main tools that photographers use to interpret the world are edge and light. They are two basics differences of how camera vision departs from our vision.

EDGE & LIGHT

Molly Savage. The use of light is not obvious in this image, but the use of edge is very obvious. The image is not framed the way the viewer expects.



THE EDGE: Unless we are in a car or looking out some other window, we do not normally see the world with a frame around it. Photographs have definite edges (frames). This is one way they differ from reality or how they abstract reality. For this assignment do not just put your subject in the middle of the frame—use the edges very obviously. Cut things off, put them to the side. Hide them outside the frame. Make it edgy! At least unexpected. And if you don't understand how to use edge, then just cut things off using one of the four edges of your camera frame. Put the thing people expect in the photograph half outside of it.

THE LIGHT: You are not photographing the things in the world, but light reflected off those things. Think about this while you are walking around with your camera. Do not photograph objects, photograph light. Look at light that is revealing things closely. If you don't understand this, then take photographs of shadows. They obviously show light.
Each of your photographs should either show obvious light or obvious edge, and if possible, both!

Convert all of your images to black and white for this project. Color is great, but tends to obscure light interactions. If you can learn to see tonalities in black and white, it will make even your color images better.

And turn off your flash at this point and keep it off. Your built-in flash might be useful at times, but not when you are learning photography. All you really can learn is that you have to be close to your subject for the flash to illuminate it.

While doing this project you might find that nice light isn't always very bright. In dimmer situations you need to brace your camera carefully and perhaps even use a tripod.

EDGE & LIGHT



TOP Suusen Ng. The edge is not obvious, although one could argue differently. The light is very obvious.
BOTTOM Alex Gheysens. In this image both the light and the edge are used in obvious ways.
Notice that these two images on this page 'talk to each other', with the guitar neck visually continuing to the top image.



Portrait

If you can imagine all of the photographs that have ever been taken in a big pile, how many of those would be pictures of people? I would venture a guess that it is a lot. People have a never-ending fascination with... people. Portraits get to the heart of this. Here a portrait is not a snapshot. It is a thoughtful rendition of someone else's image. It says something about the subject, and most probably also some things about the photographer and perhaps even their relationship to the subject.

Obviously the formula portraits that you get from Walmart are not included in this definition. Nor are quick or candid snapshots. It is relationships that matter here. Who is the subject to you? What are they doing? How comfortable are they? Are they doing something? Try to make the images meaningful.

PORTRAIT




LEFT Leslie Davis. A portrait doesn't have to be a head and shoulders shot.
RIGHT Somto Mogbogu. This image is very formally composed.
BELOW Katinka Kober. This interpretation is much more relaxed.
Notice the lighting used for these images.



While taking these, experiment. Look at the light and how it falls onto a face. Notice the background and control it with the position of the subject and the camera. Perhaps point up or down at the subject (this makes a big difference). You might even try to direct them like a movie director directs the actors. Take control of the situation—remember that photographs are not reality, but an interpretation of it. Your interpretation.

Different subjects will present different challenges. You are shooting your subject, so understand their apprehension and nervousness. One fact that photographers are aware of is that people tend to lose their apprehension the longer you take to photograph them. So perhaps after the first half-hour of shooting they will drop that photo smile and present something more genuine.

Try to find a subject that is tolerant of you taking time with them, and make sure they are not hungry (feed them!) or otherwise preoccupied. If you know someone who loves to have their photograph taken, it is easier. Your subject may even help you make photograph decisions. This project is a collaboration after all.

PORTRAIT

LEFT Luke Gibbs. One could argue that this is not a portrait, but it could be argued back that the viewer is actually getting a lot of information about the person on the bench enjoying a spring day.
RIGHT Haley Flores. This is a much more what we expect a portrait to look like, and could even be a senior picture. It doesn't matter how you make a portrait, but it does matter if it is intentional.

Color

The importance of color in photography is self-evident. Most photographs taken today include color, and here you will try to be intentional about it. Intentional color is a tool that all photographers use.

Deal with color directly while doing this project—take images that depend on color. High or low saturation, dark or light colors, different colors. Look for color and arrange those colors in the viewfinder. What are the variations within a color or two colors? What colors are there in your frame and how do they compliment or contrast with each other? If there are neutral areas in the frame how do the colors react with those areas?

Think about colors you like. Are the colors subtle or do you like colors that pop?

Don’t just lay out a bunch of colored paper and shoot photographs of it (or the equivalent). Yawn. Instead go out and look for color and color combinations, look at your entire frame, arrange, &c.

COLOR



LEFT Kyle Barton. Red is a pretty loud color, especially in saturated amounts.
ABOVE Miranda Fober. An old box of crayons. Notice how the photographer didn’t just lay some crayons out to photograph them.
RIGHT Alicia Ford. Color doesn’t have to be bright to be effective. Neutral areas can help give colors harmony.



To help you be concerned about color, you want to set the camera to the white balance dictated by the light you are using—at the very least it helps you to think about the color of the light. And beware of two different colors of light hitting your scene. Light from a window will almost always have a different color than indoor light.

You will probably want to set your white balance back to automatic after you are done. If you are shooting in RAW format you can always override the camera’s white balance guesses, but if you are shooting in JPEG format a wrongly-set white balance will render the images with worthless color.

Interaction

When you see a person with a tree directly behind their head you probably don’t even notice. But if you take a photograph of this, you will, and the tree will seem to be coming out of their head. Visual interactions such as this are something that photographers notice and use with almost every photograph they take.

In simple terms, it is how photographs are composed. How are the near things interacting with the background? How do two things next to each other relate? By asking these questions you can avoid unintentional interactions and embrace intentional ones.

COLOR

Stefan Hansen. If you walk around sensitive to color, you may be surprised at the combinations waiting to be photographed.



INTERACTION

Megan Karels. The interaction between the foreground and background is obvious.

Position two (or more) things in your frames to visually interact with each other in obvious ways. You can use something in the foreground and something in the background, but you could also have the things on the same plane.

INTERACTION

LEFT Jessica Glendenning

RIGHT Matthew Ollendick

In both of these photographs the interaction moves the viewer's eyes back and forth between the two main subjects, which have similarities, but are not the same.

In other words, the main subjects in each photograph are visually interacting!

Make sure you are making VISUAL interactions. Two people holding hands or someone drinking a soda are NOT necessarily visual interactions! The things in the camera frame need to relate visually. This can either be juxtaposition, where two things are placed near each other in the frame and contrast, or it can be two things that relate to each other and make your eye move back and forth between them (think of a picture of twins to understand this).

What you are really trying to do is get the different things in the camera frame to 'talk to each' other visually. If you are really at a loss on how to understand this, perhaps just fall back on a common photo-joke where someone in the foreground is 'holding' something in the background (like holding up a water tower or eating a car). Or you could have two people pretending to react to something very different expressions. Or you could select an object and put it in front of different backgrounds.

Self Portrait (not selfie)

This project departs from things photographers do every time they take a photograph, and instead presents you with a variety of technical and aesthetic problems somewhat like the ones photographers encounter daily.

In taking a self portrait there are three considerations: The first is how do you want to portray yourself for others to see? It can be fictional, real, one or more aspects. Remember, photographs are not reality, but an interpretation of it!



SELF PORTRAIT

LEFT TO RIGHT Self portraits by Jacob Holsteen, Sarah Olmstead, Gabrielle Celease Fox, Nicole Lettau (after clown makeup), Molly Anderson

Theatricality is a good approach to a subject you know too much and also not enough about.

The second consideration is how you actually view yourself. At least some of these should include your face, which is kind of at the root of our self-perception (for better or worse). But there are also bits of you in people you love or objects you covet (or objects you love and people you covet!). Don't use clichés here. Your teddy bear collection may be important to you, but does it really communicate that to others? ...Perhaps, but only if you do it right.

The third consideration is technical. How are you going to make the photographs? You could find reflective surfaces or use your camera's self timer. Perhaps just your long arm, but stay away from making this a selfie, and be more thoughtful about it. Try not to have someone else take the photographs, since this introduces a variable that isn't helpful.

Note: If you are doing this with the camera's self-timer, focusing might be a problem. Just focus on something that is the same distance from the camera as you will be, then switch the focus to manual to lock in that distance.

SELF PORTRAIT

LEFT Kate Shindelar. This is very much like a standard portrait, but feels incredibly direct and honest.
RIGHT Brei Aspenson. We find a lot of the identity of ourselves in our family, especially in our parents. This photograph could also fit very well with the interaction project.

Multiple Images

You've probably noticed by now that photographs together can work very much like words and sentences together to express thoughts and observations. Photographic essays have had a long history from magazines to blogs.

Make a story using six or more images together. Display these together adjusting color and tonality so they work together. Through these photographs, and without words, you should explain something. How you do this is up to you. If a picture is worth a thousand words you have the equivalent of at least 6,000 words with this project.

MULTIPLE IMAGES

LEFT Jess Macauley. Six different views of flowers add up to a seventh interpretation. This approach is a photographic essay.
ABOVE Shin Yasu. A narrative with a beginning and end to the story.
RIGHT Megan Pratt. These images have strong visual relationships to each other. They also tell a (somewhat loose) story.





Your interpretation may be external—a very literal story like a photo-essay reading from the upper left photograph to the bottom right. Or it may be very internal, and explain your feelings or thoughts like a poem or philosophical abstraction. Or it may be anywhere in between. You may want these photographs to work together visually, but they don't necessarily have to.

Body

Just about every person responds to the human body. In that pile of all photographs that have ever been taken, you won't find too many photographs of the human body, but the ones that you do find will be appreciated. Photographs of the body can of course be sexual, but pornography is the ransom note of photographs: not thoughtful, but does get your attention. Do something thoughtful.

MULTIPLE IMAGES

LEFT Roland Ferrie. Combining images can be done in Photoshop, a layout program, or just putting physical photographs together.
RIGHT Chelsea Spangler. You don't have to be very understandable when combining images. Poetry can be symbolic or more about a feeling than literal meaning.





Photograph different parts of the body. You can think of this as very much like the portrait assignment in the way that something like hands are expressed. Or you may think of it like the light and edge assignment and the way that the shape and texture are revealed by light. Or you may approach the assignment differently. Experiment.

In general, light is going to be extremely important to this assignment, and you may very well want to photograph using a window for light. What this means is that if you do not have a tripod or other support, your shutter speed will probably be very slow. Hold 'er steady. And your aperture is going to be very wide. Focus carefully and don't plan on having much depth of field. Try to anticipate how the final print is going to look before you shoot the photograph.

Color is also going to be very important in this project. You have several ways to make sure it is good. Shoot in RAW format (as always). Carefully adjust color balance (temperature), and saturation/lightness/hue. If you haven't spread your photos out on your screen to directly compare color and exposure, then do it for this one. We can tell when skin color is 'off'.

BODY



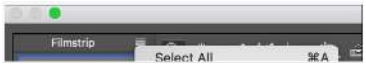
TOP Molly Schmidt. This is obviously not a portrait since the intent is to show the shapes of the body.
LEFT Katie Zimmer. The contrast of the body with things that have different qualities can have interesting visual and literal interactions.



PANORAMA & HDR

PANORAMAS

To make panoramas in Camera RAW, simply select multiple images, then in the same menu go to Merge to Panorama.



The different projection options can be tried to see what works best. Basically, the choices come down to how the program deals with straight lines that no longer remain straight when the camera is turned (see illustration below).

Camera Raw needs plenty of overlap with the images (if in doubt take a lot of images), and it works best when all of the images are the same exposure.



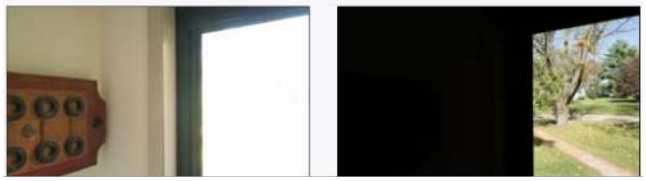
You can also use this technique to either take a wider-angle view of something or stitch together images to make a high resolution file. In these situations shoot each image vertically for horizontal images (and vice-versa).

HIGH DYNAMIC RANGE

RAW images are capable of recording a wide range of brightnesses, but they can't record very contrasty scenes like sunsets, night shots, or even looking out a window.

In very high contrast situations you can take several pictures at different exposures and combine them with the menu item Merge to HDR (in upper left illustration). The resulting HDR image has an incredible amount of tonal information which can be made visible with highlight/shadow adjustment and local controls.

There are limits to what you can do with HDR, and the resulting images can easily look very unnatural. Like bad postcards from the last century.



When taking photographs for HDR make sure you take enough photographs for Camera RAW to figure out how to align them. You only need the Deghost options if there is movement of something in the frame while you are taking the pictures.

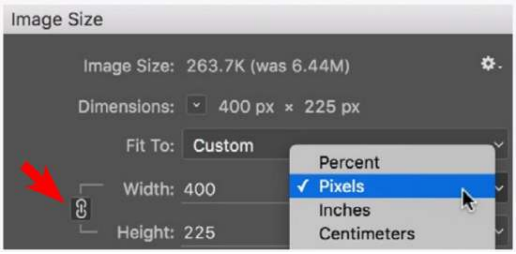
ANIMATED GIFS

1 Take several photographs that you want to see move in sequence. It may be just two if you want simple movement, or many more if you want complex movements. Most GIFs use under 10 photographs.

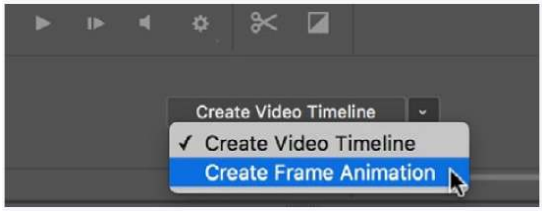
2 Open these photographs in Photoshop. If they open in tabs, make your window very small and drag the tabs out of the window to make a separate window for each image.

3 With the move tool (top tool), drag the second image you took onto the window of the first image you took. Hold down the shift key while you are doing this to automatically align the images. Now take the third image (if there is one) and shift-drag it to the first image. Continue with all your images.

4 Go to the menu Image> Image Size. With constrain proportions (red arrow below) locked and resample image box checked (lines appear from it), enter a pixel dimension in either the width or the height boxes. GIFs are generally pretty small—anywhere from about 100 pixels wide to 800 pixels wide. Click Okay, then set the image to 100% (the actual size it will be in any other application) by double-clicking right on the magnifier tool. If it is too big or too small, undo your image size and do it again using a different pixel dimension value.



5 Open the Layers Panel by going to the menu Window> Layers. Now open the Timeline Panel (Window> Timeline). Choose Create Frame Animation as shown below (little triangle), then click on Create Frame Animation to activate it.



In the Layers Panel, uncheck the visibility (eye icon) of all your layers except the one on the bottom (titled Background). A thumbnail of this layer will show up in the Timeline Panel. Change the number under the thumbnail to the amount of time you want the image to show in your animation. Usually it is less than one second.

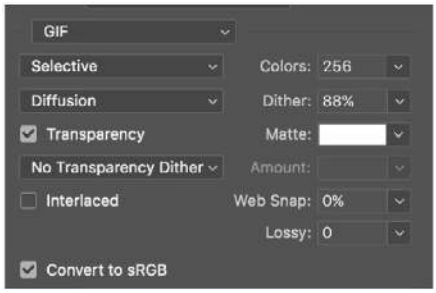
6 At the bottom of the Timeline Panel, click on the icon for a new frame (the '+' icon next to the trash can icon). You will notice that this will make a second thumbnail image next to the first, but they are the same. Go to your Layers Panel, and click on the visibility of the layer called Layer 1. You will notice that now the second thumbnail in the Timeline Panel corresponds to your second image.

7 Repeat the above step for all the subsequent layers in your image. Test the animation by clicking the play button in the Timeline Panel, and adjust the times under the thumbnails to speed up all the frames or only some of them. Click and hold on the Once button in the timeline panel and change to Forever (if it is not already).

8 If you would like to add more frames (perhaps to make the animation run backwards after it runs forwards) just add more frames in the Timeline Panel, and with the specific frame selected, click only the visibility of the layer you want in the Layers Panel.

9 To save your GIF, go to File> Export> Save for Web (Legacy).

Fill in the boxes on the top right of the box as shown in the illustration below. Click Save, specifying where you want to save it. You may want to also save your Photoshop file in case you want to do further work on it.



That's it! Test it by dragging the icon for your GIF to a web browser icon. Drag it into an email document and send it to someone. Or drag it into a presentation to show it there. Any application that supports animated GIFs will show it as you made it.

OTHER TECHNIQUES

LIGHT PAINTING

There is no rule in photography that says that everything needs to be exposed at the same time. In a dark scene with your camera set to a long exposure you can do many things.

During a long exposure you can take a flashlight (or other light) and literally 'paint in' the lighting in a dark scene, moving the light across the area to expose certain parts of it.

Hold it on one part longer, it will be brighter.

You can also turn that light towards the camera, and make a drawing in the air, or do both things during one exposure.

Different lights have different qualities. LED lights sometimes flash on and off so quickly you don't notice the flashing, but it they are moving, the camera will notice.

You can also do a lot with the color of lights, such as put colored pieces of plastic over them. With the light of a cellphone screen you can easily choose the color.

You are not limited to moving the lights. You can also move the camera to paint with light.

Ali Kilburg



Austin MacTaggart

Light painting steps:

1 Find a darkened room or go out at night.

2 Set your camera to manual mode.

3 Set your shutter speed to B or to a very long exposure like 30 seconds (if set to B you will have to have something to hold down the shutter button or a remote release).

4 Set your f-stop to whatever it needs to be (do some tests).

5 Set your focus to the approximate distance and turn off auto-focus.

6 Set your camera on a sturdy support, but for some you could move your camera during the exposure.

7 Take and retake as needed.

8 Experiment and have fun.



Tyler Jonsrud



Gabrielle Celease Fox

STEREO (3D)

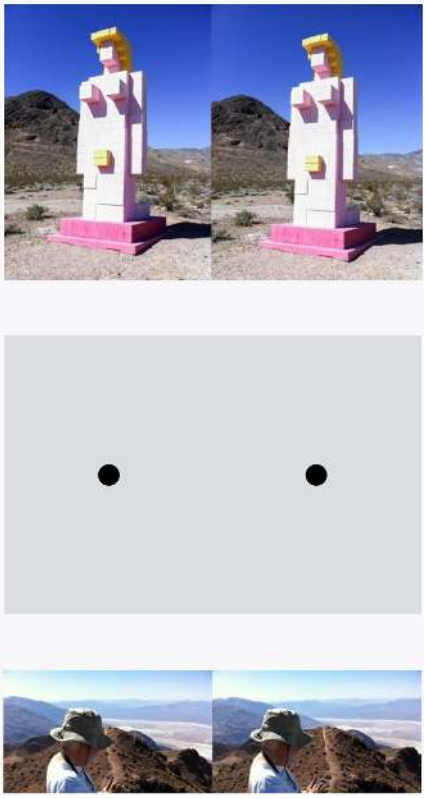
Cross-Eyed Stereo

At normal viewing distance, look at the pair
of dots in the middle illustration and slightly cross your eyes until you see three dots, then concentrate on the middle dot and bring it into focus.

If you can do this, try it the same way with the top pair of images (the woman sculpture). You should see depth.

To make your own cross-eyed stereograph, simply take two photographs pointed at the same subject, but for the second image rock
a bit to the right so the images are taken from a point about two and a half inches apart. You can move more for an exaggerated depth. Don't worry about being too precise.

On the screen (or in a print), put the image taken on the right to the left of the other and use this viewing technique. Keep them small since the bigger they are the more the viewer's eyes need to be crossed.



Pie-Eyed Stereo

More difficult to view is the pie-eyed technique. Now again look at the dots, but this time stare past the dots. While continuing to stare, move your eyes closer to the dots until they overlap into three dots.

Here is the tricky part—concentrate on the middle dot, then slowly move away from the dots until you can see the middle one in focus, while still seeing the other two dots on the sides in your peripheral vision.

If you can do this, you will be able to do the same with the bottom pair of images, and you can see depth in the image.

Of course, you can also make or buy viewers that can make this viewing easier.

To make a pie-eyed stereograph, take photographs as you did for the cross-eyed, but this time put the right image on the right and the left on the left. As big as the pair can be is about 4 inches across since a bigger pair would require the viewer's eyes to splay out in different direction—an ability very few people have!

PHOTOSHOP TECHNIQUES

This section refers to Photoshop as the image editing application, but there are others that work just as well with the following techniques.

Photoshop is an incredibly deep application. The reason for this is that multiple techniques can be combined. For example, image blur is one technique. But you can also limit blur to just colors or tones. Or, you can combine a heavy blur with no blur so that you have a unique quality of blur. Or you can just blur parts of the image or vary the blur across the image. What you can do with just a blur runs into hundreds or thousands of variations. And each will look different with different images.

There are three ways of approaching this issue of the ‘bottomless’ nature of Photoshop.



LEFT Heidi Hanson
RIGHT Hanna Cox

The first is to know everything you can about Photoshop. This would be another book in itself, and it still would be incomplete.

The second approach is to find things on the web that step you through a technique. This works best if you can find something that approximates what you are after.

The third way is a combination of the first two. Find instructions for techniques on the web, but try to understand what is happening and why the steps of the instruction are there. Look up the techniques for certain techniques you don’t understand. Buy a book on Photoshop.

That last method will help you learn the things YOU need to know about the application, and that is about all you can do. If someone tells you they know everything about Photoshop, they are a liar (a cheat, a dirty scoundrel—but I digress).

COMBINING IMAGES SIDE BY SIDE

There are many ways of combining multiple images in Photoshop. Often students’ biggest problem is actually figuring out exactly what they want to do before they start doing it.

A few pointers: Black or white is your friend. Transitions can be hidden with any color, but they are much easier with black or white.

Image sizing is actually very important, and you should figure it out. Otherwise it is easy to bloat file sizes into gigabytes by only combining a few images.

Consider using an application other than Photoshop for combining images. There can be much less of a learning curve because image sizing does not come into play as much. Illustration programs also allow you to combine type with your images without having to worry as much about typography’s additional resolution requirements.

If you are printing, consider wide format printing. Printers that take 24 inch to 44 inch paper are common, and you should be able to have a copy shop or photography studio make your image big. Prices vary widely.



TOP TO BOTTOM Ayako Shimizo Randi Westervelt Deidra Whipple

COMBINING IMAGES INTO ONE

Like combining images side by side, there are many ways of combining images together into one image.

Again, the first thing to do is get a firm concept of what you want to do, then figure out how to get there. But be prepared to change your concept somewhat to fit your skill level.

Often you need to tailor how you shoot the images as the first step in combining them. Do several tests of your idea before shooting the entire project.

Some ways of combining images are very easy. In the bottom right image the same person is photographed multiple times in a scene, then the images were simply combined as layers in Photoshop and parts were erased.

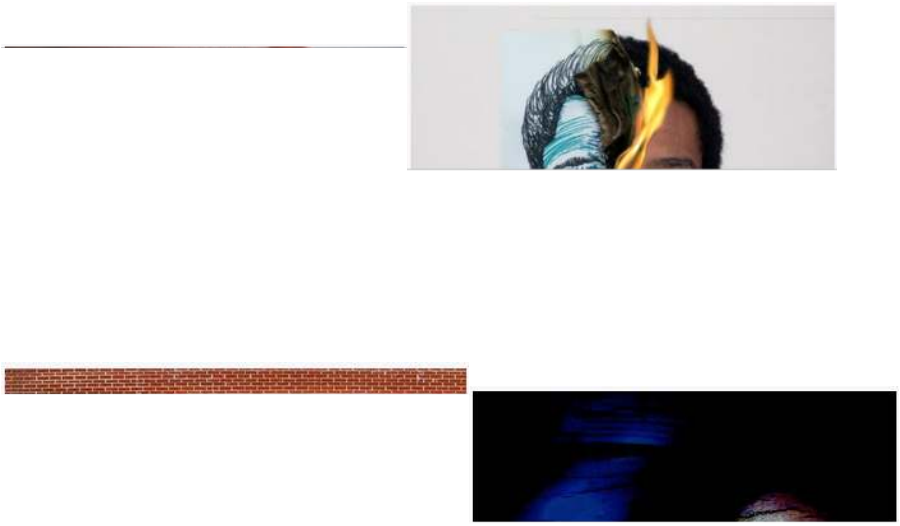
CLOCKWISE FROM ABOVE Abby Shannon, Megan Howe, Luke Salzwedel, Trevor Finchcamp

MULTIPLE IMAGE EFFECTS

Many special effects in Photoshop start with combinations of images. For instance, you can take a photograph of a textured surface, and then apply that texture to another image, either imparting it's color, tonality, or both.

It is impossible to outline the infinite ways this can be done, but you can browse through Photoshop instructions on the web to get an idea of what is possible and how to do specific effects. For example, you can combine multiple images to get greater depth of field (focus stacking). Or 'wrap' images onto other images (image wrap or displacement map)

If you are going to be doing images with a lot of handwork, a pen tablet (often called a Wacom tablet because this brand is ubiquitous), is a critical piece of equipment. Some things work better with a mouse or track-pad, but drawing is not one of them.



LEFT TO RIGHT
Matt Ollendick
Michael Benson (fire self portrait)
Courtney Mehus
Lauren Kahler

PHOTOSHOP MISCELLANY

There is a plethora of information on the web covering a myriad of Photoshop techniques to do this, that, or just about anything. As noted before, Photoshop is very deep since most effects used in combination produce still more effects.

Some common effects are polar coordinates, which makes an image a small planet; and selective blur, which is used for everything from making something look miniature to making a false lack of depth of field.

You can also colorize a black and white image or combine the original color of an image with a black and white version.

Just a tour through the Photoshop filter menu will present you with a multitude of ways to improve an image... or mess it up.







LEFT TO RIGHT
Jessica Grant, polar coordinates Spencer Albers, selective blur Kendall Platt, filters etcetera Chrissy Schweiger, color and b&w

COPYING FLAT MATERIAL

WITH A COPY STAND

Using a copy stand is the easiest way to take photographs of artwork (or anything that is flat and less than about 16 by 20 inches).



Preparation

Attach the camera to the copy stand, making sure back of camera is parallel to artwork. If it is not, rectangular material will be rendered trapezoidal. You can use a level to be precise.

If lights are not placed at 45 degrees to material, adjust them, making sure lights are pointed to the center of artwork or a little beyond center. Set your camera to a zoom setting about midway between wide angle and telephoto. All zoom lenses bend straight lines, but the effect is almost always less at this setting. For more accuracy you could do tests to see where the exact setting for your zoom lens renders lines straight.

Setting exposure

Turn off any lights other than your copy stand lights. If you have exposure controls on your camera, set it to manual mode and the lowest ISO. Adjust aperture to f-8 (on many lenses f-8 is the sharpest aperture). With artwork in place, set the shutter speed as necessary to obtain good exposure: If your material is a neutral gray, then it should be neutral gray in the resulting image, if it is light, then it should be light, and dark should be dark. For more accuracy, take a test photograph of a white sheet of paper. Adjust your shutter speed so that the histogram for the resulting photograph shows the hills near (but not at) the right side of the scale.

However you arrive at your shutter speed, use the same speed for all of your photographs. In this way, dark material will show up appropriately dark and light material appropriately light.

Setting the white balance

If you have your camera set to save JPEGs, you need to adjust the white balance. One way to do this is to set it for 3200k, or indoor lighting (represented with a light bulb symbol). For more accuracy, set it manually using a white sheet of paper (see your camera instructions). For even more accuracy, take a photograph of a white sheet of paper at first using RAW format. Take the rest of your photographs using RAW format and set all to the same color balance (color temperature) as your white sheet in your image editor like Photoshop. Always use RAW image format for the best quality.

Focusing

Ideally, every time you move the camera height you would want to focus manually. In practice, this doesn’t work very well. Instead, use the automatic focus on your camera. If your camera has a hard time focusing on material, temporarily place something

with detail on it (like a sheet of typing). Press the shutter button down half-way to lock the focus, then remove the sheet and take the photograph.

Taking the pictures

Even if your shutter speed is fairly short, there is always the possibility of moving the camera slightly when pushing the button to take your photographs. To avoid this use the self-timer so that the camera fires after you push the button. Many cameras have a 2 second delay for the self-timer which is made for this purpose.

It is also a good idea to turn off any image stabilization (or vibration reduction) if your camera has these settings. If your camera is on a sturdy support having this setting on might actually increase blur.

For even sharper images you could use a remote release. Some cameras even have a way to lock the mirror up before you take the photograph so that the movement of the mirror won't jar the camera, although this is generally not needed unless you have a very flimsy copy stand.

Take and look

Take several shots, then view them on the computer. Enlarge them to see if there are any problems. If there are straight lines (like the edges of the artwork) are they straight? Is the artwork framed okay? Is your exposure good? Are your colors fairly accurate or is there a color cast? Is everything sharp? When you are sure everything is okay, take the rest of the photographs.



Painting of Beirut Harbor by Arthur Frick

WITHOUT A COPY STAND

Sometimes you can't use a copy stand because there isn't one available or your artwork is too large to be evenly lit with the copy stand lights. In this case, you can use a tripod, two lights, and a pin-up wall to make your own very big horizontal copy stand.

The illustration of the copy stand is seen from the front. Instead, imagine it as a lighting set-up looking from above with the artwork pinned to a wall.

Place the camera so that the back is parallel to the artwork. This is a little more difficult than with a copy stand. One easy way to do it accurately is to have someone hold a mirror flat on the center of your artwork. When you can see your camera centered in the mirror you can be sure everything is parallel.

How far away the lights (at 45 degrees to the artwork) should be is also something you will need to figure out. If they are too close, the work will not be evenly lit. If they are too far away, you will have to use overly long exposures and you run more risk of reflections, especially if the artwork has glass covering it. Turn on and off each light to better see how each is illuminating the artwork. Watch for any areas which are brighter with each light (hot spots).

How you arrive at your exposure, color balance, and other settings is just like with using a copy stand.

WITHOUT ANYTHING

Sometimes you might not have the luxury of having any equipment other than a camera (you definitely need the camera).

You want as much light as you can get while staying away from direct sunlight (which would accentuate any texture or defects in the thing you are copying). Also try to find a place that is amply lit from the side. The image above is photographing on a porch. You can also use a wall to put the artwork on or just put it on the ground and point the camera down.

Setting exposure

Just use the Program (P) setting on your camera. The light may change, so you don't want it on manual mode. Also, the program setting does a pretty good job of determining the optimum shutter speed and aperture combination. For artwork that is lighter in tone, set your EV adjustment to +1 or +2. If the artwork is darker, set it to EV -1 or -2. Experiment.

Setting the white balance

Set the white balance on the camera to daylight. You could also use the same white balance methods as for the copy stand, but if the sun goes behind a cloud your white balance will change.

Focusing

If your camera has a hard time finding a focus, then point it at another part of the artwork, hold the shutter half way down to lock the focus, then recenter and take the photograph.

Taking the pictures

If you are shooting with a tripod, a level can make sure the camera is level with the art. If you are hand-holding your camera you definitely want image stabilization (vibration reduction) turned on. Also try to hold your camera against something. Your forehead works well if you are using a DSLR. If you are using a smaller camera with a viewing screen, put the neck strap around your neck and pull against it to steady the camera. If there is something else like a chair handy to steady the camera, use it!

If your pictures turn out blurry, then you may want to also set your ISO to a higher setting. Set it only as high as you need to get sharp images.

Other considerations

The success of this method really depends a lot on the reflective qualities of the artwork you copying. Thick acrylic or oil paintings have gloss surfaces that depart in small areas from being parallel to the main surface. Glass presents daunting reflection problems. Pencil lines may disappear if graphite is reflecting light badly. And so on.

But, if you are careful and thoughtful, you can do very high quality copies of many types of things with nothing but a camera and your keen eye focused on what you are doing.

PROCESSING THE IMAGES

No matter what method of shooting you use, processing the images in the computer should be fairly straightforward. Count on the lighter tones compressing—in other words, it is difficult to come up with something which has the exact same tonality as the

original.

Most image processing programs have provisions for correcting non-parallel lines that result when your camera is not perfectly parallel to the copied material. These corrections can be automatically applied to all of your images at once.

Also, if you are using manual exposure, you should be able to correct exposure and contrast to one image and then paste the same correction to all the images.

CELLPHONE CAMERAS

Cellphone cameras are handy, traveling along with you almost everywhere you go, and are incredibly easy to use in most situations. They also have features that your camera might not have, such as automatic HDR, very good low-light capabilities, panorama capabilities, location data applied to every image... the list goes on, and yearly it expands to include more features.

The disadvantages of a cellphone camera mainly stem from a very small sensor — about the width of a pea. Physics dictates the limitations of image quality here, but various software 'tricks' (such as combining multiple images) help to mitigate those disadvantages. So much so, in fact, that for small images on a screen the images can look just as good as those taken with a camera. Actually, in the hands of someone without photographing experience, they can even look quite a bit better.



An unadjusted cellphone image. If you would have stood in the same place with the same cellphone you would have gotten the same image. Assuming your lens was wiped clean.



A night shot without a tripod. With a camera this scene would have necessitated a tripod, but with a cellphone camera, it was just a pull from the pocket, an aim, and a push the button.

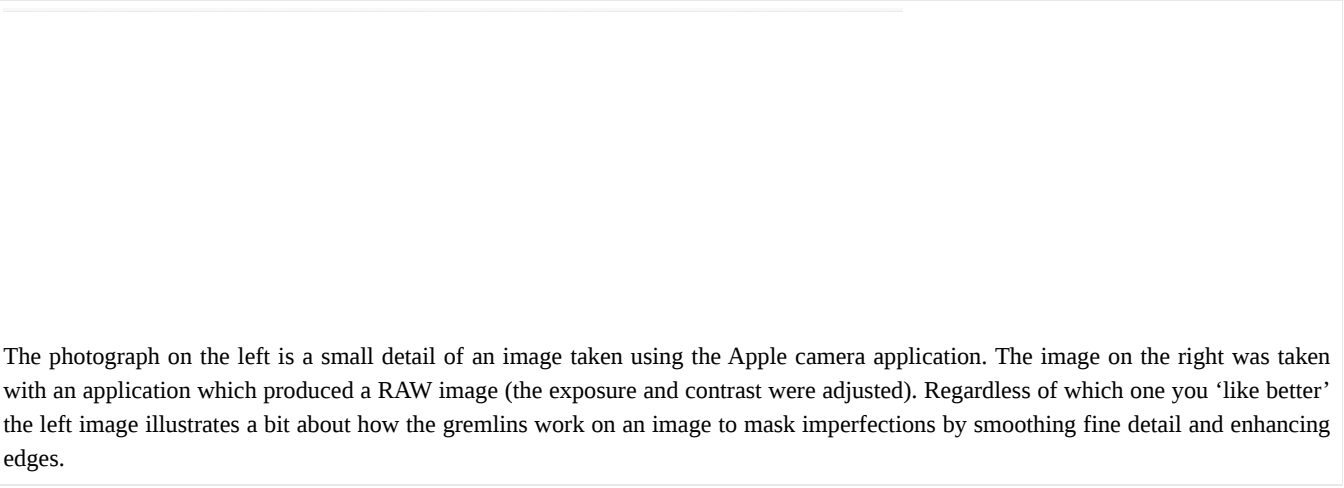
Cellphone Camera Software

Even before you take a photograph with a cellphone, little AI gremlins get to work on that image. How much light is there? What does the contrast of lighting look like? What does the histogram look like? Is that sky or a face? The gremlins make a lot of decisions based on these and other things, all in the hopes that you will look at the image they made and congratulate yourself on a photograph well-taken. They can even give you different versions of the photograph starting before the time you pushed the button.

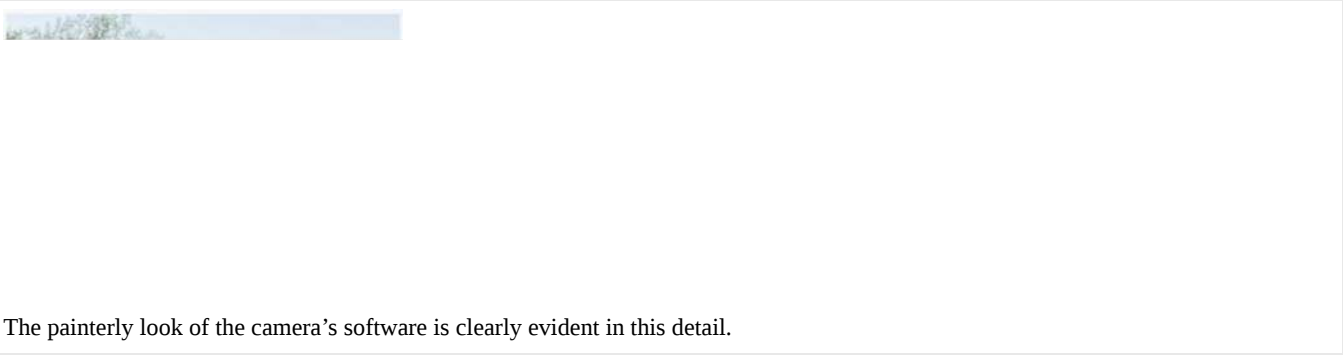
Those gremlins are smart in a way, and many times the fruits of their labor will give you the image you want. At other times they can present you with flesh-tones that look like a quarter-inch of makeup, skies that are so blue they only exist at forty thousand feet. And detail that looks like someone smudged it all up with a paintbrush. And the worst thing is you have little or no control to improve that image to suit it to your taste.

This sounds like a criticism, but it is really not. I use the standard camera app on my camera-phone at least half the time I use my cellphone camera, if not more. It is, after all, EASY. You don't have worry too much about the amount of light available or holding the camera steady. You get a pretty good shot no matter how distracted you are, and really, if I wanted an image I could control a lot I would be using a dedicated camera.

But there are times when it would be nice to have some control over a cellphone image, and for that you need another application. Adobe Lightroom includes a camera function, and there are others that are quite inexpensive. At the time of this writing one of the best of these is Halide. With Halide installed on your phone, you can have better control while shooting since it is easier to selectively focus and change your exposure. But best of all, you have more control with your processing, since you can set it to shoot RAW images (in DNG format) in which the tones can be stretched and pulled when you edit the image. You can't control tonality to the extent that you can with a dedicated camera image, but you are not stuck with the tonality the gremlins dictated when you took the image.



The photograph on the left is a small detail of an image taken using the Apple camera application. The image on the right was taken with an application which produced a RAW image (the exposure and contrast were adjusted). Regardless of which one you 'like better' the left image illustrates a bit about how the gremlins work on an image to mask imperfections by smoothing fine detail and enhancing edges.



The painterly look of the camera's software is clearly evident in this detail.

Lens & Aperture

Because cellphone cameras must be thin, they cannot use an optical zoom lens. The digital zoom that is available just takes part of the image on the sensor, so the marginal quality of the image just gets worse. I am sure you have experienced this.

The best solution to this problem is to have multiple lenses on an cellphone camera. Actually this is multiple cameras, since each lens needs its own sensor. By combining these cameras, the software can mimic a zoom lens or do other tricks, such as forming a 'depth map' that can be used to different parts of the image blurry, (badly) simulating a large aperture.

This is useful since the aperture of cellphone cameras is not adjustable, and even if it was, would not be able to render depth of field: The actual focal length of the lens is simply too small to significantly put the background out of focus with photographs taken

at normal distances.

Image Format

The applications that come with cellphone cameras give you photographs in either of two different formats. JPEG should be familiar to you, and it allows for small file sizes and compatibility with other software and devices.

HEIC format is also used. This format is much more flexible than JPEG, and allows multiple images to be stored in the same file package. So, multiple images or depth maps can be stored in the same place, allowing for later adjustments. Since this file is not compatible with many other applications, when you send an image or transfer it to another application it is often converted to another format and any additional images (or depth maps) are stripped from the HEIC file. For example, if you send someone a still image, that image will be sent as a JPEG. Or, if you send a small HEIC file animation made with an Apple cellphone, the file will be converted to a GIF file, an animation format that any device can decode.

RAW format does not need much explanation here. It is the same as other camera RAW formats, except you should not expect the wealth of information that RAW format can provide in cameras. You can still easily change the white balance, but exposure changes and color information will be more limited since the small sensor is not able to capture it in the first place.

The Future of Cellphones

The fact that cellphone cameras do as well as they do in ease of use and quality is a surprise to me. In other words, I don't know what the future of cellphone cameras hold.

Physics limit the image quality at this point, but there are many experiments attempting to work around these limitations. For instance, one newer cellphone fits the length of a telephoto zoom lens into a thin phone by using a mirror to change the direction of the lens to align with the side of the phone. Another solution is adding a larger sensor to the wide angle lens, since that lens requires less distance from the lens to the sensor.

Perhaps more computing power will add to cellphone quality, or perhaps just more lenses. An array of lenses (with sensors) could theoretically enhance image quality, and other experiments, such as attaching a larger sensor/lens combination external to the phone might prove fruitful. Or might not.

Or, it might be that the technology that is already out there just gets more fine-tuned. Is there really a market for better quality cellphone images when at this point they are good enough for more people to post on Facebook and Instagram? Stay tuned.

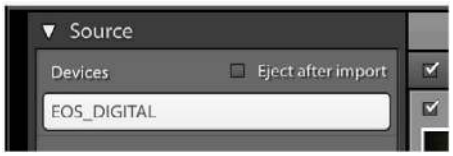
1LR ADOBE LIGHTROOM

SET UP LIGHTROOM

Before you even open Lightroom, connect the camera's SD card to the computer. Also connect the hard drive or flash drive where you will keep your images and catalogue—you may want to make a folder on this drive called Images.

Now open Lightroom and go to File/New Catalog... in the menu at the top of the screen. Name your catalogue and save it your external drive (hard drive or flash drive).

As the application directs you, click the Import... button to show the Import window. On the upper left select your camera's SD card as the source (where your images will be coming from).



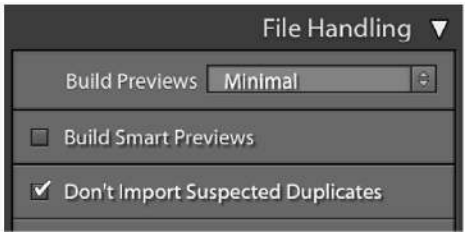
At the lower right of the Import window select your drive as the destination (where your images will be copied to).



In the illustration above I had previously made a folder called Images to put the photographs in. Do not put them in the folder that is titled with your catalogue name—this is a folder Lightroom made when you saved your catalogue (here named Lightroom Images).

Study the options you have when importing images. Most of these are on the right hand side of the Import window. Many of the options you might need now are self-explanatory.

In the File Handling category (panel) there is an important option to not import duplicates.



You should choose this if it is not checked. Lightroom does not delete images from your camera's SD card after you import them. Instead it assumes you will leave them on the card as a back-up, which is a very good idea. The next time you import images, it will overlook the images you have already imported with this option activated, only retrieving the newer images you have taken.

If you run out of room on your SD card, you can buy a new card or delete the images manually outside of the application (see below).

Speaking of backups, Lightroom will at some point ask you if you would like to back up your catalogue. Importantly, doing this will not back up your images, but only the information (such as organizing) you have added in Lightroom.

Since you are just starting out, you probably don't need to back up the catalogue since you could easily rebuild it by making a new catalogue and re-importing the images.



One last thing to do is make sure your camera's SD card has been ejected from the computer before you remove it. This can be done automatically from Lightroom (next to source option) or from outside the application. Not ejecting your card will hide forever any files you may have deleted (and subtract that file space from your card).



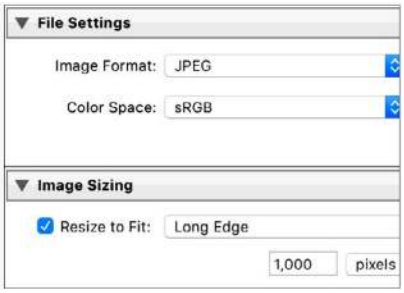
Your camera stores images in folders on the SD card. Folders and files can be deleted the same way as other files on the computer.

1LR LIGHTROOM DEVELOP MODULE

Adobe Lightroom doesn't actually change your images, but instead adds instructions to your original images as to how they should be changed whenever they are viewed or exported. It does this by adding instructions to either the application, the image itself or more commonly in a separate file called a sidecar file.

What this means is that Lightroom doesn't actually change an image until you export it—if you make wrong edits or completely mess up an image, you can always go back to the original, just as it came out of the camera.

Since your adjusted RAW images cannot be opened in most applications, you might want to make a copy of the image to send to someone (or place into another program or whatever). In the Library module (see previous page) go to Export... (bottom left of the window) set the destination, give the file a name, and probably set the file format to JPEG with the color space set to sRGB. If you are emailing the image you can set the size as 1,000 pixels for the long edge.



BASICS OF DEVELOP MODULE

Change Lightroom from the Library to the Develop module on the upper right. If you cannot see the Basic Panel as shown you can scroll the panels up and down.





These two views can be set to specific magnifications in the Navigator Panel. With an enlarged view you can also move the image around by dragging the box overlaying the Navigator panel's image.



Below the image in the Develop module are the view controls. The first icon on the left will present the selected image (Loupe View). The second icon takes you to Reference View where you can select two different thumbnails to compare different images. The third icon allows you to compare the same image Before & After adjustments.

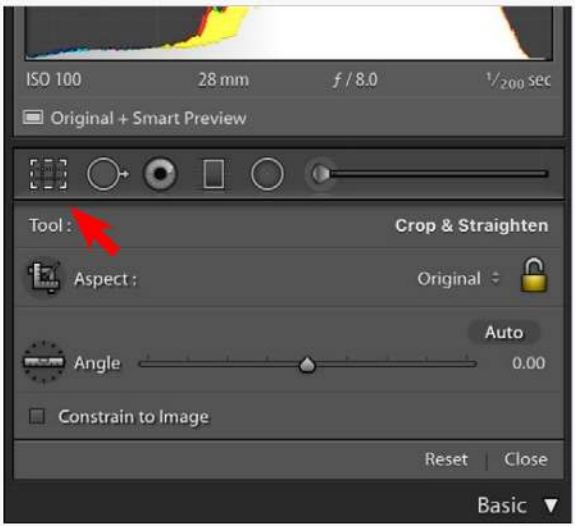
The small triangles next to the last two icons activate pull-down menus to choose the type of arranged views you want.

The three icons on the right allow you to switch adjusted and non-adjusted views. Essentially these allow you to undo adjustments or confirm adjustments in preparation for more adjustments.

Experiment with these buttons and get used to using them. Adjusting photographs is more than just sliding a bunch of sliders. Also, for explanations of the buttons, just rest your cursor over them for pop-up explanations.



You may have to scroll down in the left set of panels to see the History Panel. This panel allows you to select any previous adjusted state of the image, even long after you have made the adjustments.



The Crop Tool (red arrow) is in the set of tools in the right set of panels. As with all of the tools, clicking on it will reveal options for the tool which appears below it. Clicking the tool again will confirm or cancel the tool and close the options panel.

Crop an image by dragging on the image itself. You can always reset the crop or constrain it to different proportions by using the options in the tool's panel.

The preferences for Lightroom are in the Lightroom menu. Take a quick gander at these, but don't change anything you don't understand.

Each catalogue also has its own settings in the Catalog Settings directly below the preferences menu item.

1LR USING THE CONTROLS

You may notice that there are some controls that are not covered here, such as that little Auto button next to the exposure and contrast sliders. I bet you can figure many of these out yourself, and they may even be useful sometimes.

Keep the instructions on the previous pages at your side while you import, organize, and adjust your images in Lightroom.

Drag the sets of panels to resize them in Lightroom. Sometimes you might want the adjustments panels on the right to be small for a big image, other times you might want them big for easier adjustments. You also may want to hide the filmstrip at the bottom of the window by clicking that little triangle right near the edge of the screen. Try it.

Rate your best images, then view only those in the Library module using the controls at the top of the thumbnail views. Make a collection and put some of your images into it.

Adjust the white balance, exposure, and contrast with different images. Although not all images will need adjusting, you should get very familiar with what the changes look like.

Go ahead and try other image adjustments as well, but be aware that the other adjustments can easily work against each other and most images just need the first three adjustments.

COMPARE, DANG IT

It always amazes me how students will make changes to an image and then compare these changes to an image they only hold in their memories from before the changes were made. This only works for extreme adjustments, and is not good for eking out the best in an image.

Instead of comparing changes you have made to an image in your memory, use the before/after buttons. Sure, these are a little difficult to get the hang of, but they are important.

The following are questions you should ask yourself about this section of Lightroom instructions.

CAN YOU...

Import images using Lightroom and know where those images are being stored?

View and organize a set of images in Lightroom?Scroll through panels and resize sets of panels?Make a collection and put images into it?

Sort your best images by dragging them in a collection?

Find information about your images, including the time and date they were taken?

Export a sized JPEG image from Lightroom?Adjust the white balance of images?

Adjust the exposure and contrast of an image?Easily reset an adjustment slider to 0.

Zoom in or out of an image to see details or entire image?

Look at different areas of an enlarged image?

Set the white balance using the eyedropper when a neutral area is available?

Crop images?

Use comparison views to see changes clearly?

Use comparison views to move adjusted images back and forth or reset them?

2LR MULTIPLE EDITS

Here are two things that don’t necessarily have much to do with the operation of Lightroom, but are necessary to control your images.

Set Lightroom Background to White

If you hold the control key and click and hold on the border of your image (you may need to reduce the magnification of your view to see the border), you will have the option to make the background white.

This is a good idea if you are going to print your image or otherwise show it on a white background in an email or on the web.

Adjust Your Display Brightness

Different computer displays have different brightnesses, and even the same display appears at different brightnesses relative to the level
of room light. This is a problem, since you can correct an image to be just perfect, but change the room light or the display and the result is not perfect.

The easiest method to adjust display brightness is to hold a piece of white paper to the side of the display and adjust the brightness of a white area on the display to match (or make a bit brighter) than the paper.



In Lightroom you can select multiple images by selecting one image and then holding down the shift key to select the last image in the sequence. You can also select images that are not next to each other by holding down the command key while clicking on them.

When you have multiple images selected, you can adjust one, then apply the same adjustments

2LR PRINTING

To print from Lightroom, go to the Print Module at the top of the window. Most of the controls here are pretty self-explanatory (don't forget to scroll to see all of them), and you get a preview of how your image will appear on the paper in the main window.

One thing that might seem odd is that there is no provision here for changing your paper size. This must be done by going File > Page SetUp... in the menus at the top of the screen.

As you change the Margin Options (borders of the print) in Lightroom you might notice that the numbers don't quite correspond to your actual margins. One reason for this is that your image always remains in proportion. The other reason is that your printer may not be able to print as close to the margin as you have your numbers set to.

There are also options for printing multiple images on one sheet of paper. To do this, select multiple images and adjust the options in
the Layout panel until the preview shows the arrangement you would like.

The first time you print, choose the Printer... button at the bottom of the panels. Here is where you set up your printer. After you print using this button, for subsequent prints you can just click the Print button. The settings will remain as they were for the first print and the image will be sent to the printer.

Other Modules

Choosing modules in Lightroom is like changing applications, but as you have probably noticed, some things carry over from one module to the next, such as images that are selected and collections you are viewing.

You might not need these other modules, but if you are curious, here is what they do:

The Web Module is like printing, but instead of prints it generates web pages. The designs (templates) here are fairly long in the tooth, but who knows, you might find them useful.

The Book Module generates PDF books of images. Some book printers, such as Blurb, also make plug-ins that allow you to generate a book and send it to them for printing.

The Slideshow Module allows you to make slideshows for viewing with Lightroom.

The Map Module shows you where you took your images if they have GPS information embedded. Your camera phone probably embeds this information, but your dedicated camera probably does not.

You can also record location information on images by dragging their thumbnails onto the map. Selecting multiple images locates that set in one place.

Remember that all of these instructions are just to get you started, which in most ways is the hardest part. More information about specific parts of Lightroom are easily found elsewhere.

2LR USING THE CONTROLS

FIRST THINGS FIRST

Think about this for a second: Say you have a photograph that you are viewing on a dark Lightroom background. How are you going to know how light the lighter areas are? They may look very bright, but is that because your monitor is set to a high

brightness? You can't tell. I know that because I can't either.

Set your background to white. Yes, I know it doesn't look as cool, but for any photographs that are going to be printed or shown on a lighter background, it is the easiest way to judge the tones in an image.

But what about the darker tones? Yes, you can tell how dark the darker tones are better with the background set to black. But for a variety of reasons this is less of a problem unless the final viewing situation is on a black background.

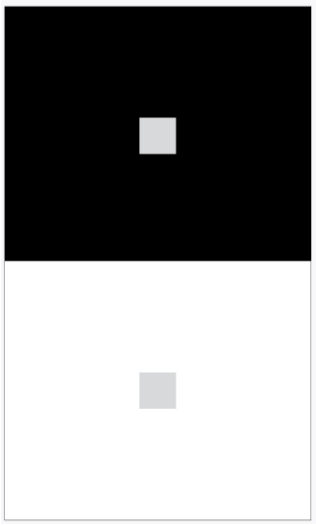
Adjust your display brightness or you may have an embarrassingly bad image when you show someone the photograph you adjusted on a display that was set too bright.

MULTIPLE IMAGE ADJUSTMENTS

Try selecting a few images in Lightroom, then go through the steps of adjusting one then applying that adjustment to others.

REVIEW

Now is a good time to go back to the previous chapter (1lr) and review the things there while you are sitting at the computer. These are important basic techniques that we will be building on later.



Even with all the white on this page, it is difficult to tell how dark that little square is when it is on a dark background. It is much easier to see when the same square is on a white background.
By the way, did you notice that all of the pages of this book are not actually white? Probably not, since in most PDF viewers there is nothing which to compare (key) the white.

DID YOU...

Set your Lightroom background to white and adjust the brightness of your display?

Notice how I repeat some things a lot?

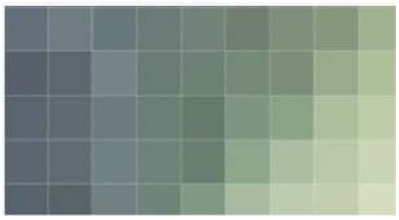
CAN YOU...

Make an adjustment to one image, then apply that adjustment to other images?

Print an image?

Still do everything covered in the previous Lightroom instructions (1lr)?

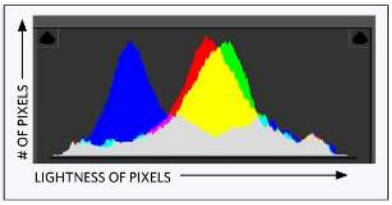
3LR HISTOGRAM



Every digital photograph is made up small squares called pixels (a shortening of picture elements). You don't normally see these because they are too small in most viewing situations. Each of these pixels is only one color. When there are enough of them (they are small enough) your eyes see these not as squares, but as continuous tone and color.

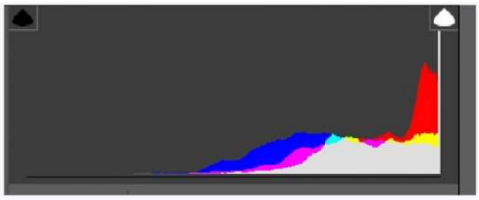
When editing photographs individual pixels don't matter too much, but how the pixels work together does matter.

The histogram is a map that shows the pixels working together. The number of pixels of a certain tone give the hills height, and the tone of the pixels give it width, with the darker pixels on the left and lighter on the right. It is an essential tool that shows us another perspective and can illuminate problems with images.

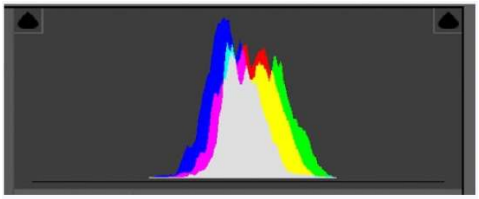


The Lightroom histogram shows the levels of each of the three primary colors of the pixels.

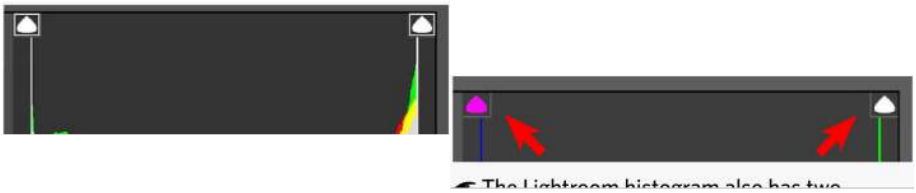
Proof of how important histograms are is the fact that you see them in any image editing application, and even as a display option on your camera.



Overexposure. The histogram indicates the exposure likely needs to be decreased.



This histogram shows no darks or light tones, perhaps indicating that more contrast is needed.



Good photographs can be very dark, very light, or have a lot of clipping. But the histogram helps you to be intentional about what you are doing.

3LR TONAL ADJUSTMENTS

Before adjusting the following options in Lightroom, first adjust White Balance, Exposure, and Contrast.

Here is when you adjust the others:

Highlights

These are the lighter tones (or colors) in an image. After you adjust the brightness and contrast, sometimes you will find that the lighter areas in the image are too light and so without detail. Bringing down the highlights will correct for this.

Shadows

These are the darker tones (or colors) in an image. If they are too dark without detail, you can lighten them to correct for this.

Less often with both highlights and shadows, you may need to adjust the other way. Such as if the highlights are too dark or the shadows too light.

Whites

These are the very light areas of the image. Be careful adjusting these since all of the spark of an image can be dulled with too low a setting and all detail lost with too high of a setting.

Blacks

The very darkest tones. Making them too light will render the darkest areas gray and muddy, so be careful with this adjustment also.

Texture

The edges of small repeating details are sharpened to enhance the impression of texture.

Clarity

Clarity is like contrast, but works at a more detailed level. As with all the adjustments, try the extremes to see what they do.

Vibrance

Vibrance is like saturation, but protects skin tones and already saturated colors from getting too saturated.

Saturation

Saturation is how intense the colors appear. With no saturation you have a black and white image, and with a lot of saturation the colors ‘pop’ unnaturally. This is a common control, and since contrast also effects saturation, it is often needed when you make a contrast change.

Saturation, along with exposure, contrast, and white balance work linearly on the image, while the other adjustments use a bit more ‘intelligence’, which can lead to a very artificial look when used without discretion.



(Dehaze is not a commonly used adjustment)

3LR USING THE CONTROLS

HISTOGRAM

You may notice that histograms on cameras are dealt with in Chapter 6 of this text. The histograms in Lightroom are basically the same, but they are more immediately useful when editing images. That is why they are introduced here first.

Get used to looking at histograms as you adjust images. They help you see what is happening to the tones of an image, and so are very important. As you get better at the controls they will become even more helpful... but only if you know how to use them.

TONAL ADJUSTMENTS

Most students tend to drag the more advanced controls discussed here wily-nilly in strange ways. Be intentional!

Lightroom comparison view showing difference of only shadows adjustment

In other words, do the basic exposure and contrast adjustments first, then invoke the others only as you need to. So, if you adjust the exposure and contrast, then find you need the shadows to be lighter, only then use the shadows slider (see example of this below). Adjust the same way for the other controls.

This is a good time for you to review how to compare images side by side (1lr) so you can see exactly what is happening when you make an adjustment. Just make one adjustment at a time (then reset it) to see what each slider does.

All of this takes practice. I wish I could tell you how to use any control in Lightroom and suddenly you would know how and when to use it, but it doesn't work that way. Practice is the only way to learn these controls. This book only gets you started.

CAN YOU...

Understand the basics of what a histogram is showing about your image?

Predict the contrast and exposure needs of an image just from the histogram?

Turn on and off the clipping buttons to see the tones outside areas of an image?

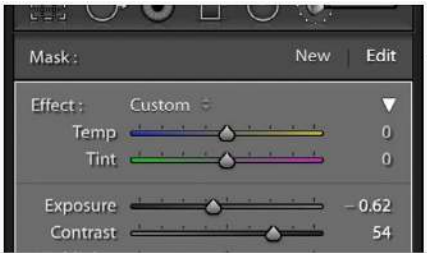
Understand the function of all the sliders in the basic tab of Lightroom?

Identify and change the sliders by dragging directly on the histogram?

4LR LOCAL ADJUSTMENTS

The Lightroom adjustments covered so far work across the entire image. For example, when one area is made lighter, all areas of the same tonality will become lighter.

But what if you could adjust only part of an image without influencing other parts? This is what *local adjustments* do. To start making these, click on the *adjustment brush* icon at the top of the window (red arrow).



The adjustments possible with the adjustment brush should be familiar to you by now.

You can make adjustments either before or after painting the area for them, but you should probably set the approximate adjustments you are considering before you start painting—this way you can see the results as you paint.

Important: Using the adjustment brush in this way you are not changing the tonality of objects

Trevor Finchcamp, before local adjustments



Trevor Finchcamp, after local adjustments to darken the top area of the image and lighten and increase contrast on bottom



Original image

Background area was lightened and foreground area darkened. The sculpture on the left was lightened more by using auto mask (next page).

4LR MASKS

A Mask in Lightroom is simply a selected area. When you are painting in adjustments, you can turn on the mask right below the image.



This will allow you to see the areas you are painting with a color overlay. Showing the mask is simply a viewing aid —it will not change the image.

Auto Mask

Much different than this mask is the Auto Mask. When turned on (red arrow below), the adjustments brush will attempt to find boundaries in the image and constrain the painting to within those boundaries. This is the way you use the adjustments brush to adjust things instead of areas in the image.

Often when using auto mask you should first paint along the edges of the thing you want adjusted, then turn off Auto Mask to paint in the rest of the thing to be selected for adjustment.

Painting and erasing (also using auto mask) at enlarged views is a way to refine the edge, and you may have to repeat this several times to get the right masking edge.

Auto mask does have its limits. Edges in images are not clear cut, and often include transition pixels that are neither the color of the object nor of the background.

In general, do not expect to make radical adjustments using auto mask to define things.

The image above shows the red mask defining areas painted while using Auto Mask on the right and a darkened sky on the left. While auto mask does a good job in large areas with definite borders (the beak), it has a very difficult job selecting smaller areas and areas with less defined edges (like the small feathers on the top of the bird's head).

Hard edges are actually composed of transition pixels (below right) which can cause problems with extreme adjustments when using the auto mask.



4LR USING THE CONTROLS

LOCAL ADJUSTMENTS

Being able to adjust only parts of an image is a powerful technique, but one that takes a lot of practice. You might as well get started now.

Pick some images that might need an adjustment in areas that is different from the overall adjustments, and see what you can do. Make things lighter, darker, and maybe increase the contrast. Try changing the color of an area using the white balance tools at the top of the adjustment brush panel. Try to instead change the color using the Hue slider.

Perhaps find some images that don't need obvious adjustments. Can you improve the image using them? In general, lighter areas draw the viewer's eye and darker areas recede. Can you use this fact to control the way the viewer sees elements in the image?

Experiment. As always, view your changes side by side with the unchanged version to compare them.

AUTO MASK

Use auto mask to limit your local adjustments to just one thing in the image, such as the sky, or perhaps a person's face which is too dark in relation to the rest of the image.

Get the hang of how accurate auto mask can be by enlarging the adjusted image to 1:1 (100%) to view it. In general the heavier the adjustment the more accurate auto mask needs to be.



Small section of a photograph before and after the sky was darkened with the adjustment brush using auto mask. The transition line along the horizon is very obvious on the adjusted image. Auto mask does have limitations, especially with the heavy adjustment seen here.

Two options to hide this limitation would be to make the adjustment not as extreme or make the photograph (and therefore the imperfections) smaller—as shown at right.

CAN YOU...

Effectively change only parts of an image?

Make your local adjustments seem natural?Erase and add to portions of your adjustments?Use appropriate brush sizes and feathers?

Use flow to control the strength of the adjustments within an adjustment area?

Make multiple adjustments and then go back and edit each one individually?

View your adjustment areas using a mask?

Use auto mask to limit adjustments to objects (tonal edges)?

Use auto mask to paint edges, then fill in areas to be selected with auto mask off?



5LR CURVES

The Tone Curve

Curves are another way of adjusting tonality in an image. There are two modes in the Tone Curve panel. For the tone curve mode, make sure the Regions are showing below the curve. If they are not, click the small button in the lower right.



Adjusting on the Image

Click the small circle in the upper right of the panel to activate direct image adjustment.

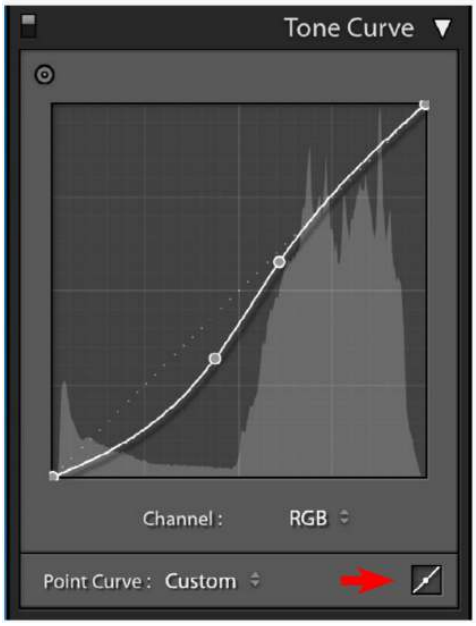


Now pick an area of your image and drag the cursor up or down. All areas with that same tonality will get lighter or darker. This is a great way to tweak an image to the correct tonality.

You can look at the tone curve in the panel to see how the changes being made to the tone curve (which you can instead adjust directly by dragging the curve itself or the sliders below). When you are finished dragging in the image to adjust the curve, click the small button in the upper right again.

Curve adjustments have a different effect than the adjustments in the basic tab (highlight, shadow, whites, blacks). In short, adjusting the curve will generally give a more naturalistic look, but also can make the image look flat (low contrast) in areas.

You can also change the extent of your tonal adjustments (highlight, shadow, whites, blacks). Click and drag the three small triangles touching the bottom of the histogram.



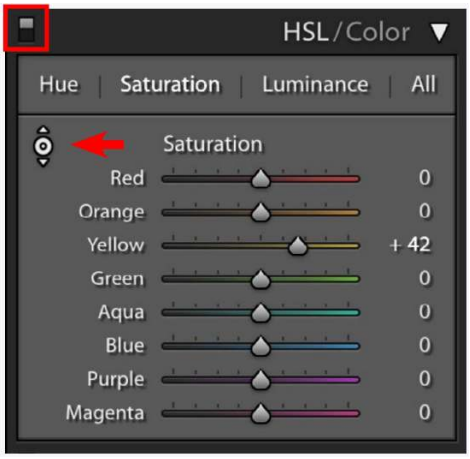
By clicking the Point Curve button (red arrow) you can free-edit the curve. This is somewhat tricky and because of this has limited utility at this point. Still, try it.

You can add points by clicking on the line and remove them by double clicking on them.

Although the point curve is more difficult to edit, it is very powerful. Playing with it can show you the extent (not the refinements) of the adjustments possible.

You can also adjust the three color channels individually, but it is my fond hope you will not need to any time soon.

5LR COLORS



The small switches in the far upper left of adjustment panels (red square) allow you to toggle on and off the adjustments within that panel.

Adjusting Discreet Colors

The HSL/Color panel lets you adjust discreet colors. Activate direct image dragging using the small button (red arrow) as you did with curves.

Click and drag on an area in the image with the panel set to Hue, Saturation, or Luminance.

Hue: Allows the shifting of the color to another similar color.

Saturation: Controls the intensity of the color.

Luminance: Controls the brightness of the color.

The images at right show some of the controls for adjusting colors in Lightroom. Typically, the controls are used more subtly to correct skin tones, sky color, and over or under-saturated colors.

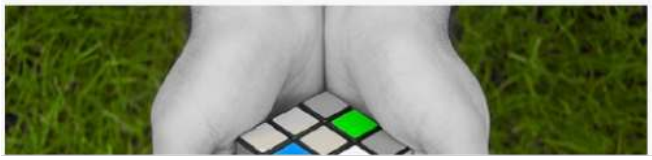
Instead of dragging directly on the image you can of course adjust these colors directly with the sliders in the HSL/Color panel.



Gabrielle Calease Fox (original image)



Green hue, saturation, and luminance increased, blue saturation and luminance increased.



All colors except green and blue desaturated.

5LR USING THE CONTROLS

TONE CURVES

Using the tone curve to adjust tones is an alternative to using the controls discussed in the last chapter. It is really handy because you are actually editing the histogram directly (see it behind the curve?).

Unfortunately curves don't always help you if you are also using the highlights/shadows/whites/blacks controls since they somewhat duplicate their functionality, but in an entirely different way.

Play around with the parametric curve to see if you like the way it works. Try it on several different images. It may work great for you for small adjustment, but the other controls may work better for large adjustments. At the very least remember them so that you can try them again on an image you can't get just right.

COLORS

Color adjustments are essential. Practice them, play with them, and remember them.

Although at first these adjustments may just seem like fun because you can change your blue car into a green car, in reality they are very useful for tweaking the color of everything. Getting that skin tone just right. Adjusting the color of the sky that your camera got wrong.

So play now, but remember these controls. You will need them if you care about good images. Modern cameras are pretty good with color
in many situations, but they often need help with interpreting that color. And color in a photograph is not reality, but an interpretation.

POINT CURVE

Mess around with the point curve. The worse thing that could happen is that you understand image tonality a bit more.

The illustrations to the right show three different curves. The first is the unadjusted image. For the second image the tones (and colors) were reversed by dragging the lower left of the curve to the top left and the lower right to the top right. The curve for the last image is shown below it.

Point curves are usually used for fine adjustments to tones (and colors). I doubt that you will need or want to do this right away, but playing can help you understand how the point curve could be an important advanced control.

CAN YOU...

Use the targeted adjustment tool on your image to adjust the parametric curve sliders to improve and image?

Change the extent of the four tonal areas on the parametric curve?

Add, move, and delete points on the point curve?

Understand what hue, saturation, and luminance is when referring to a color?

Adjust the hue, saturation, and luminance of individual colors in an image?

Make an image black and white and change the tonality of the original colors?

6LR MORE LOCAL ADJUSTMENTS

In addition to the adjustment brush, there are two other local adjustment tools in Lightroom. These behave the same way as the brush, and like it you can define multiple areas with their own separate adjustments.

The Graduated Filter allows you to define an adjustment area by clicking and dragging in an image. This is helpful to do something like darken a sky. Where you first click is the extent of the fullest part of the adjustment, and where you drag to defines the area where the adjustment fades out (the feather). You can move this adjustment or edit it with a brush.

The Radial Filter allows you to adjust a circular or oval area. This might be used for making the center of an image lighter to emphasize it or to correct for dark edges produced by a lens.

Like the adjustment brush, there is a feather adjustment for the effect, but unlike the brush, the effect does not coincide with the oval drawn. Fifteen minutes of playing around with this tool is worth more than all explaining that can be done here. Neither the radial nor the graduated filters do anything that the adjustment brush won't. But they do make some things easier.

The graduated filter used to darken the background and draw attention to the mired mare



A circular radial filter used to make the horse very obvious in the image

6LR RANGE MASKS

You may have noticed that you don't have all the adjustments over a local area that you do for a whole image. One important thing missing is the ability to change the hue, saturation, or luminance of colors only in one area.

The solution to this is the Range Mask. After painting in an adjustment area (it can be really rough), you can limit that area to only work on a certain color. Set the range mask to Color, then with the eyedropper tool (red arrow) in the image click the color you want to adjust.



You can expand your color area by picking on similar colors with the shift key held down, and/or you can drag across an area with the eyedropper. After you select the color(s), use the Color range slider to expand (or narrow) the range of colors selected.

The statue in the bottom image at right was very roughly selected and the white balance was shifted. That selection was then limited to the statue by shift-clicking with the eyedropper on several parts of the bronze.

Instead of limiting an adjustment brush to a color range, you can limit it to a Luminance Range (a range of brightnesses).

After you make your rough selection, drag the left Luminance range slider to limit the adjustment area to the lighter areas, or the right slider to limit it to the darker areas. Experiment with this after you have made the adjustments you plan to make.

After your luminance range is picked, use the Smoothness slider to fine-tune the adjustment area.

In the bottom illustration the graduated filter was pulled over the top two thirds of the image and the sky was darkened. Then the left luminance range slider was pulled to the right until the adjustment did not include the foliage.

You can edit your adjustment masks even after you define a color or luminance range. Making the mask visible and/or holding down the option key while moving the sliders may help you see the affected areas when making adjustments.

The range mask will also allow you to do some of the same things as the auto mask. Which should you use? Practice and experiment.



Original image



Statue and sky with exaggerated adjustments

6LR USING THE CONTROLS

MORE LOCAL ADJUSTMENTS

The graduated filter tool is the most used in my toolbox. It is simple, direct, and very quick to use. Try using it to darken skies or the edges of images.

Try editing your graduated filter area using a brush. Erase parts of the filter, periodically switching the mask (not auto mask) on to see where you are painting.

Use both adjustment brushes and the graduated filters on the same image. See how strong you can make the adjustments. I will be willing to bet that what you think looks a bit like a ‘fakey’ adjustment will be accepted by the viewer as unadjusted.

The radial filter is much less useful as an adjustment, but when it is needed it is great. Try lightening the area where a main subject is in an image. Try using it to darken an image’s corners.

RANGE MASKS

Okay, I admit it, range masks are a little difficult considering how useful they are at this point. But they can be great in certain situations, so try them out. Then when you get to an image that really calls for them you are prepared to learn the finer details about how to use them.

Try to select different colors using the color range mask. Also try to use the luminance range mask to limit adjustments to one tonal area. Play with these controls. We are learning tools here, and the more tools you have the better you will be able to make improvements in the future when you need them.

CAN YOU...

Use the graduated filter to adjust parts of an image?

Erase parts of a graduated filter?

Erase using auto mask?

Use the flow tool to control how much to erase parts of the graduated filter?

Use multiple graduated filters and edit them?

Use the radial filter and invert the effect? (don’t tell me you didn’t see that option)

Use the color and luminance range masks in conjunction with the adjustment brush and the graduated filter?

Use the color range mask tool to limit an adjustment to similar colors?

Select a range of colors with multiple samples or dragging through an area of colors?

Use the luminance range mask to adjust only the darker or lighter parts of the masked portion of the image?

7LR LENS CORRECTIONS

Lens Profile

All lenses have faults which Camera Raw can correct by simply telling the application which lens you are using.

The first image below has parallel lines that bow out. This type of distortion, called barrel distortion, is common with wide angle lenses. The second image has this distortion corrected automatically by Camera Raw.

Go to the Optics panel to bring up the Lens Corrections panel, then choose Use Profile Corrections. With newer common cameras, Camera Raw will recognize
the camera/lens combination automatically.

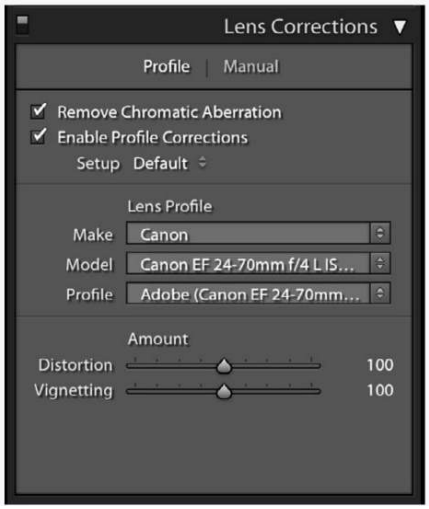
Careful inspection of the images at left will reveal another difference. The first image has darker corners. This vignetting is mostly caused by the fact that the center of the sensor is closer to the lens, and therefore gets more light. Profile Corrections also corrects for this automatically.

If the corrections for distortion and vignetting are not quite right for your image, you can always further adjust them using the sliders at the bottom of the Lens Correction panel.

If your lens is not recognized by Camera Raw, there are two things you can do. First, look for a camera/lens combination in the drop-down menus that appear when you click the disclosure triangle (arrow). Select the lens that you have or one that may be close to what you have.

If there is no camera/lens combination close to what you have, you can manually adjust vignetting and distortion using the sliders under the Manual Tab near the top of the Optics panel. This tab also has color corrections which will be covered on the next page.

These lens corrections may not be necessary, and unless you take photographs of things like buildings, you may never need them. Applying them unnecessarily will not visibly degrade your image, so you can use them whenever you have doubts, although some vignetting can sometime be beneficial to an image.



Near the corners of an image with high contrast there can be bands of color called Chromatic Aberration. It is often seen as a purple fringe around objects as you can see in the first image on the right. It may also show up as other colors, and many times one side of an object will show one color, and the other side a contrasting color.

This is easily corrected in the Profile tab of Lens Corrections panel by activating Remove Chromatic Aberration. This has been done in the middle photograph on the right.

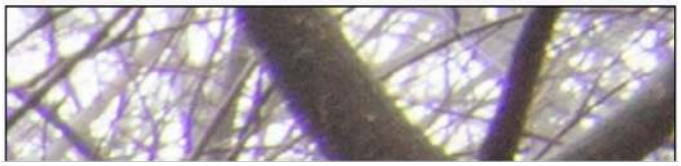
The Manual tab for the Lens Corrections panel lets you further remove the chromatic aberration colors. This is how the purple fringing was completely removed from the bottom image on the right.

Generally, when manually correcting aberration, you can just slide the Purple or Green Amount. If you do need to tweak the Hue Adjustments it will be obvious which range of colors to specify.

Be careful that you don't also remove any important details that may be colored similarly to the fringe color.

Notice that the Distortion and Vignetting controls on the manual tab have a much greater range of adjustment than the ones on the

profile tab.



Original Image (detail)

Lens profile with Remove Chromatic Aberration

Lens profile with Defringe adjustment

Manual corrections can be used instead of or in addition to the profile corrections.

7LR USING THE CONTROLS

Imagine you buy a hex wrench at the hardware store. You may never need it. But then you have to take out a screw that has a funny-looking slot on it that a regular screwdriver won't fit into. Suddenly you are very glad you bought it.

These techniques are a lot like hex wrenches. Some people need them often, some people will never need them. And some will only need them occasionally.

So, here I am taking you down the hex key aisle just in case you need it. These techniques don't take practice, just an awareness of how they work and what they are good for.

LENS PROFILE

The first thing I do when importing images is apply profile corrections. Lightroom can be set to to this automatically, and at least with my cameras it not only straightens curved lines, but also lightens the edges to make the field of tonality even.

I suggest you at least try the profile corrections on a few images to see if it improves them (the strength of the effect depends on the lens used).

Try the manual corrections instead of or in addition to the profile corrections. The profile correction is not always perfect, and tweaking it with the manual corrections may be necessary.

If you only take photographs of people, you may never need these corrections. If you take architectural photographs you may always need them.

CHROMATIC ABERRATION

How much you need to correct for chromatic aberration really depends on how you take photographs. Like the lens profile corrections, you may never need this. At least try to find an area (near edges at 100% magnification) that needs correction in an image and apply the correction. That way you will remember it is there if you find you need it later.

CAN YOU...

Notice any curvature or vignetting inherent in your lens and correct for it by applying a lens profile?

Manually correct for curvature and vignetting both in the profile and manual panels?

Notice any chromatic aberration inherent in your lens and correct for it?

8LR TRANSFORM TOOLS

Sometimes converging parallel lines in photographs are distracting. This convergence is called parallax. The Transform panel allows this to be corrected.

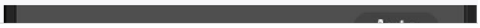
Some buttons at the top the Transform panel (at right) let Lightroom automatically figure out how to do corrections. However, the Guided option is the most powerful. When you click on it, you can draw either two lines in your image over lines which should be parallel (like the green lines in illustration), and also a second set of parallel lines which should be parallel (yellow lines in illustration). Lightroom will correct the distortion based on the lines that you drew.

You can instead correct parallax (and a few other things) manually using the sliders below the tools.



After parallax correction using the sliders, you may have white edges which need to be cropped out of the image. You can eliminate these with Constrain Crop box at the bottom of the panel.

The Straighten option associated with the Crop tool works very much the same way, allowing you to click the icon and then draw a straight line across an object that needs straightening.



A common cause of parallax comes from pointing the camera up at a building. In the second illustration the parallax is not fully corrected, as in this instance it would make the building look top-heavy.

8LR THE REST

There are a few more features that you may (or may not) find useful in Lightroom:



Paint over a duck or leaf with the Spot Removal Tool. It will replace that area with another
(movable) area. It also works on ex-girlfriends if they are small and/or far away. The Heal and the Clone options for this tool each

work a little differently, and you can try each even after you have painted in the area to remove.



The Red Eye Correction Tool does what it says. That red area in eyes is actually an image of the back of they eye which only light coming from near the lens reveals. It is more apparent in low light since the aperture of the eye (iris) is larger.



Profiles (near the top of the Basic panel) are definitions of how you want the colors in an image to be rendered. You could make one for your camera (and lighting situation), but that is too advanced for this book. Just leave it at the setting it is at or at one you like better.

All digital images get sharpened automatically somewhere. The Detail Panel lets you specify sharpening. For photographs taken at high ISOs, Noise Reduction helps you eke out as much quality as you can from an image.



Split Toning is intended for correcting image defects in older cameras, JPEG files with the wrong white balance, and possibly for an effect you might want. Images converted to black & white can also be split-toned to give them a duotone look. Just pick a color and saturation for the shadows and highlights. You can also define the dividing point of the colors between shadows and highlights.



The Snapshots Panel in the left set of panels in the Develop module allows you to save your images in stages. Just click the + at the top of the panel. These snapshots (which you can name or not) will be saved with your image, making them available in future editing sessions.

The Presets Panel (also in the left set of panels) lets you save sets of adjustments for later use (using the + symbol). Lightroom comes with presets you can also use.



The Effects Panel is a grab-bag of things that you probably won't need unless you want old-time looking images.



It is best to leave Calibration alone unless you want to get really picky about how Lightroom interprets color from your camera.

8LR USING THE CONTROLS

The good news is that (like the last set of instructions) these are options that you may or may not need, but are easy to learn.

This does not mean we have covered all of the things you can do in Lightroom. For example, things like strategies for key-wording. But most of these things you probably don't need now, and (again) this book is really intended to just get you started.

If you want to practice something, go back to image adjustments and local adjustments. Those are the things I am sure you still need to work on. For the tools here, just work through them so that you know what they do in case you do need them.

And keep this book for reference. I doubt that you can sell it for much anyway.

TRANSFORM TOOLS

If you don't have a picture of a building, go out and take one. At least take a photograph of something that has straight lines, like the room you are sitting in right now (spooky how I know where you are).

Try the various automatic transform tools. Play with the sliders. Zero out your controls and try the guided tool and draw lines on your image to straighten them to each other.

THE REST

Try each of the rest of the tools. Some may be helpful. For instance, if you often take the lens off your camera I am sure you will use the spot removal tool a lot. That dust just stays there casting its shadow on every image you take.

Your way of working may also benefit from using the snapshots panel. Or it may not.

CAN YOU...

Straighten a crooked image?

Use different techniques to correct for converging lines (parallax)?

Remove blemishes (from a pimple to an old boy/girlfriend) from an image?

Remove the image of the (red) back of the eye from a flash photograph of a person?

Save your changes to an image using snapshots?Apply split toning to an image?

Save sets of adjustments to use on other images?

Apply at least a few effects that an image might need?

Leave the camera calibration alone?

9LR OTHER CATALOGING APPLICATIONS

Phase One Capture One Pro



Lightroom for mobile on iPad

CATALOGUE APPLICATIONS

Although Lightroom is a very good cataloging (DAM or Digital Assets Management) application, there may be reasons to use another instead or in addition to it.

Adobe Bridge

A very light cataloging program. Very good at quickly assessing and editing batches of images.

Apple Photos

Very easy and nicely designed, without much versatility (no local adjustments, limited lens correction). Integrates extremely well with other Apple devices.

Capture One Pro

Best at image editing, with strong local controls. I have found it not great at cataloging many images unless they are broken into smaller sets, but my cataloging experience with it has been minimal.

Corel Aftershot

Very much like Lightroom, but cheaper and not quite as versatile, but may do everything a person needs it to do.

Camera Manufacture Applications

These range from not-so-great to worse, but sometimes include special features, such as good tethered shooting (viewing and shooting from a connected computer).

Others

There are other catalogue applications you can easily find on the web, such as Alien Skin's Exposure. Most programs have free trial versions you can use for a month. RawTherapee and Darktable are open-source and free. There are also web-centric image cataloging methods such as Flickr and Google Photos.

Lightroom

Lightroom comes in two different versions (Lightroom CC and Lightroom CC Classic). These pages have covered the Classic version.

The non-classic Lightroom is striped down and has a 'groovier' interface. It is also made for mobile devices such as an iPad. Lightroom uses an ingenious system to synchronize one catalogue with all image adjustments across devices. A limited version is free to try out.

9LR EDITING APPLICATIONS

Affinity Photo	Affinity Photo for iPad

EDITING APPLICATIONS

Without cataloging capabilities, these applications are narrower in focus and generally can do many things catalogue programs can't. So, while this book is about improving images, it is not about manipulating images (to any extent). To combine images (&c) you need an image editing application such as one of the following ones. There are too many others (such as Luminar) to cover here.

Photoshop

The best, meaning that it is the most versatile.

Affinity Photo

A solid and inexpensive application. It does all of what many photographers would need it to do.

Pixelmator

A well-respected and inexpensive application.

Gimpshop (or Gimp or Seashore)

Free versions of open-source software. Many compare these with older versions of Photoshop. Fairly versatile and you can't beat the price. While all of these are basically the same application, they have different user interfaces applied to them.

Others

There are many photo editing applications out there. You can usually download an application and try it for free. Everyone's needs are different for editing images, so it might take some time with Google to find one that is right for you.

Tablet and Phone

There are also many applications for tablets and phones made to edit images. Although not as featured as computer applications, some deal well with RAW files, and all are easy to use. Affinity Photo (shown above) is one that has impressed me. For $20 (at the time of this writing) you can't go wrong. Unless you don't have a newer iPad.

Photoshop is also available for mobile devices. At the present time it is only suitable for compositing, but Adobe promises more to come.

If you want to add drawing or painting to your photographs, there are tablet applications such as ProCreate which have many controls for this.

CREDITS AND OTHER THINGS

Image Credits

Images in this text identified with names were made by students in Introduction to Photography. I am always amazed at what students of mine create, and it is with great thanks to them for keeping me interested in teaching for many years. These images are all very good.

Images without a credit in the caption were taken by me. Some images are good, some not-so.

The History of Photography chapter contains images that are in the public domain. Most of these are from the Library of Congress, and a few of them are from my small collection.

Colophon

Pagination for this text is done for reading devices where the page index of the PDF reader will correspond with the page num-bers at the top of the pages.

The body of the main text is set in Chaparral Pro. It is clear to read on and has a somewhat modern feel without much attitude. The font also has a wide variety of weights and has contrast attributes suitable for a wide variety of viewing devices. Cap-tions and page heads are in Gill Sans Nova, which pairs well with Chaparral in this context.

Instructions are set in Witney, which has a precise look that makes difficult instructions at least easy to read, and chapter headings are Tungsten for a slight bit of attitude.

The Text

I have been teaching photography in colleges and universities for the past forty years. The primary intention of this book is to provide students with a kind of text that fits the way they learn while also providing a firm foundation in photography.

The second intent of the book is to clean house. Photography has change radically during the time I have been teaching it, and momentum sometimes dictates what I teach. Writing this text has provided a way to question what I am teaching, add things that have gained relevance, and discard things that are no longer needed. The text in the gray boxes are things that I didn't think were really needed, but nor did I quite want to toss them, either because they are interesting or because they might answer some questions students might have.

I am fully aware that not everything will be understood by all students. Experience has taught me that students' needs vary widely. So, while one student might easily understand depth of field, they might have a really difficult time with motion blur. And vice versa.

That being said, let me know if there are better ways of explain-ing anything in this text, and please let me know where there are errors. The editing of the text was in proportion to its price.

Various sets of my photographs can be found at quxl.net.

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    - 7.1: 7PH PHOTOGRAPHS LIE - *Undeclared*
    - 7.2: 7CR LENS CORRECTIONS - *Undeclared*
  - 8: Motion - *Undeclared*
    - 8.1: 8PH THE IDEA - *Undeclared*
    - 8.2: 8CR TRANSFORM TOOLS - *Undeclared*
  - 9: Exposure Controls - *Undeclared*
    - 9.1: 9PH PHOTOGRAPHS AS DOCUMENTS - *Undeclared*
    - 9.2: 9CR CATALOGING APPLICATIONS - *Undeclared*
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    - 10.1: 10PH ROCKS and TREES - *Undeclared*
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