

PHYSIOLOGY LABS AT HOME



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Prelude from Author

Necessity is the mother of invention

The development of this lab manual is actually an interesting story. I have been fascinated with physiological assessments for a very long time. I have always enjoyed finding out about my own physiological capacities or my current physiological status from relatively simple, and relatively non-invasive tests. I use the word “relatively” because plugging what seems like a gas mask on someone, asking them to wear a cold strap around their chest, then run on treadmill without turning their head too much, and running until they are about to explode IS INVASIVE to many. Understandably so! However, no blood has been taken, no organ tissues have been sampled, and no drugs had to be given.

With the onset of COVID19, many of us had to do many things we never expected. Educational classes and labs previously on ground were forced online. I taught an anatomy class where the students needed to order “organs” and dissection kits from a company. We then performed online dissections, with many choosing to use their backyards to avoid the smell in their houses! Even after COVID19 isolation was finished, many of these labs would be a valuable supplement to an on-ground laboratory course.

The main point of a laboratory exercise is to show the students in a “hands on” manner what they learned in lecture. This is very important not only to the tactile-kinesthetic and visual learner, but to future health care workers who will need to know laboratory or surgical techniques. Demonstrating laboratory activities without being in a lab is difficult at best. Various *virtual laboratory applications* have been used for quite some time previous to COVID19, and many have expanded the applications since then. Still, seeing it happen in reality and real time is more powerful! Seeing is believing! I hope you see your own physiology while doing these exercises/discussions/reports.

Inspiration from Devastation or Desperation

I started my company, *Principle-Centered Health*, because of my fascination with assessments. I also started it because Hurricane Katrina forced me out of New Orleans, and I knew that I could use the devastation as inspiration. I brought a lot of fancy equipment at significant prices, in order to test people in exercise and health related areas. I realized that there were a lot of tests requiring little to no equipment, and by simply using a calculator or a smartphone someone could find out a great deal about their own physiology in a wide variety of systems. I would make many of these easy to perform labs as extra credit for my classes.

Fast forward to the COVID and post-COVID era. With the onset of online laboratories, many people had to purchase the virtual lab applications and use the internet in very innovative ways. Many instructors had to be quite innovative with “home-made” labs. The beauty or inspiration that comes from desperation is that many scientific phenomena are right in front of our eyes on a daily basis! The ability to observe and use science to learn about ourselves or improve our quality of life is what labs should be all about. I hope this lab manual will help you achieve this and show you the many resources you have “at home”. I hope you enjoy it and learn something about yourself in the process.

Dr. Mark Kelly

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Inspiration from Desperation

Licensing

A detailed breakdown of this resource's licensing can be found in [Back Matter/Detailed Licensing](#).

Overview of Chapters

Section and System Studied	Exercise (assignment) Sub-section Name	Type
A: Basic skills & applied knowledge- A synergistic duo	A-Design an Experiment	Report
1: Calculating % Change % Difference and Diffussion and pH in home products	Part A: Calculating % Change and Difference Part B: Diffusion lab- temp and concentration effects. Part C: Acids and Bases in Home & Foods	Report Report Report
2: The Cell& Division of Labor	Part A: Analogies of Organs to Cell organelles Part B: Rooms in House to Organs/ Company	Case Study
3: Anthropometrics	Parts : A1: BMI A2: Ideal Body Weight (IBW) B1: Waist Circumference measures B2: Waist to Height Ratio B3: Waist to Hip Ratio B4: U.S. Navy BF% estimation Part C: Body frame estimations	Case Studies
4: Metabolism and Calorie Burn	Part A- RMR formulas Part B- RMR from LBM estimations Part C- Total Daily Energy Expenditures Part D- Using METs to calculate RMR/cal expend	Case studies
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8: Circulatory- Heart Rate	Part A: Heart Rate Lab Part B: Aerobic Capacity Estimation	Case Study Case Study
9: Flexibility	Part A- Back Scratch Test Part B- Seated- Sit and Reach Part C- Torso Twist	Case Study Case Study Case Study
10: Immunology	Part A- Preventing COVID 19 and its Spread Part B- Psychoneuroimmunology (PNI)	Report Discussion

Section and System Studied	Exercise (assignment) Sub-section Name	Type
11: Respiratory	Part A- The Talk Test	Case Study
	Part B- Breath Hold	Case Study
12: Digestive	Part A- The Gut Brain Microbiome Axis	Discussion
	Part B- Are you What you Eat?	Report
	Part C- Corn Test	Case Study
13: Urinary	The Vitamin OD or Asparagus Test	Case Study
14: Genetics/Development	Part A- Phenotypic Analysis- 23 and You	Case Study
	Part B_ Nature or Nurture- Biopsychosocial	Discussion

Organization of the Lab Manual

This lab manual will contain three types of assignments. The main type of exercise is called a “**case study**” and these tests or measures will be performed **on you or are about you**. Most of the case studies can be performed independently, but some are better if there is a partner.

The second type of assignment will use videos or educational materials from the internet, and you will be asked various questions from them as well as some perspective or opinions. This type will be called a video analysis and “**report**”. It is amazing how fun learning can be when it is presented this way!

The third type of assignment is “**discussions.**” Technically, this is best if you are in a course at an institution where some “discussion” or “chat room” application is available. People may comment via threads. Most of these are opinion-based and some educational videos or papers may be assigned to these as well. Social media thrives on discussions. I hope you enjoy this manual and are fully engaged.

This manual could serve a course in exercise physiology, or standard human physiology. Some systems lend themselves more toward being studied non-invasively from home, while others do not. There is a good deal of overlap in the function of three different sets of systems. It is because the systems work synergistically that we see this apparent overlap. The **first triad** is between metabolism, body composition, and nutrition. These sections will be presented in that order in this lab manual. The metabolic rate is a function of cells utilizing chemicals in a particular manner. The nutrition components one ingests can alter the metabolic rate or the metabolism of someone, and the body composition will change accordingly. Also, if someone has a high percentage of muscle, they will have a higher metabolic rate and “throw off” some of the formulas which use body weight to approximate fat amount.

 Interrelationships between metabolism, body composition, and nutrition are presented in a triangular fashion. Bidirectional arrows are used between each pair.

In a similar fashion, it is hard to separate **the second triad**- cardiovascular, respiratory, and aerobic capacity or muscle endurance. The cardiovascular system can only transport oxygen if the respiratory system obtains it, and the muscle’s mitochondria can only utilize oxygen, if the cardiovascular system transports it.

 Interrelationships between cardiovascular, respiratory, and aerobic capacity are presented in a triangular fashion with bidirectional arrows between each pair.

Interestingly, the *smart watches* on the market now, can not only monitor heart rate, but they can also monitor your speed, cadence, and incline or ascent. Some can even take an EKG and even monitor the quality of their sleep or stress levels through heart rate variability, and breathing rates at rest. This manual will not expect anyone to have a “smart watch” but it can be helpful and fun to compare the findings of the watch to some of these studies.

A **third triad** of synergism exists with the brain, our special senses, and balance. Most would consider these quite distinct, yet balance or equilibrium is a function of your sight, proprioceptors, and the reticular system in the inner ear. The perception of sight is due to many interpretations from the brain. It must take in the visual data in the optic lobe and make sense of it in the visual cortex and frontal cortex. Thus, optical illusions are due to these interpretations. In addition, if there are cerebellar issues in someone, their balance or coordination will be thrown off. This is why the drunk driver field tests are performed!

 Interrelationships between brain, equilibrium, and special senses are presented in a triangular fashion with bidirectional arrows between each pair.

We will explore the body in 14 Sections in this manual or course. Each section is covering a different organ system or area. For example, anthropometrics is simply body measurements, and it primarily applies to body composition and girths. This would be a combination of a couple of organ systems. Likewise, metabolism and calorie burn would involve several systems as well. Please remember that you can “isolate” a system in a living body. In science we call this “in vivo” vs. in place “in situ” or looking at isolated cells would be “in vitro”.

Nutrition is a topic that spans several sciences not to mention physiological systems. What you put into your body determines both what resources the body has to replace or regenerate a given system, but it also have endocrine and biochemical effects. This course or manual is only touching the surface of what can be explored in the world of nutrition including nutrigenomic effects and phytochemical effects, as well as the role of our microbiome on our health which is a hot topic of discussion in wellness and health!

A final note, as you go through the various exercises, try to have both an introspective perspective as well as an inductive perspective. So, what this means is look at yourself, both physically and mentally. I really want you to examine- how you tick. Athletes do this on a regular basis, but much of humankind does not. Secondly, look at the collective pattern of outcomes in your life to form a theory or overall theme. For example, you may see that you are good with health habits when things are good, but as

soon as “life” falls apart, so do you! This is not a “self-help manual” and no medical advice is offered, but it can be used for some guidance, should you choose to use it for such purposes.

CHAPTER OVERVIEW

1: Calculating % Change and Difference and Diffusion

- 1.1: Part A- Percent change
- 1.2: Part B- Percentage different
- 1.3: Part 2- Diffusion- Temperature and Density/Concentration Effects
- 1.4: Section 1- Worksheet 1
- 1.5: Part C- Acids and Bases in your Home and Foods

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1.1: Part A- Percent change

Section 1: Calculating % Change and Difference and Diffusion

Part A: Calculating Percent Change and Percent Different

Percentage Different and **Percent Change** are different terms with different calculations. In general, you will compare before and after scores **within the same individual** with percent change. You will compare two scores **from different sources** with % different. This is not always the case, but most often it is the correct procedure.

In statistics, they will have different T-tests for each example (within vs between subjects T-tests). The percentage different says nothing about the statistical significance, only the magnitude of change or difference- relative to the values. Thus, two really large numbers with small differences will have very small % differences, but two really small numbers with that same small difference would be much larger.

A. **Percent change** will be measured by (After- Before)/ Before. Depending on the variable it may decrease or increase as an improvement. For example, if it was time to finish a given running distance the time would decrease with improvement and be represented with a negative number.

If I ran a mile in 8 minutes and 30 seconds before training, and 8 minutes flat after it would be easiest to calculate in seconds or minutes. It would be (8.0 minutes - 8.5 minutes) divided by 8.5 minutes.

Thus, the negative number here represents an improvement. $-0.50 / 8.5 = -0.0588$

Take -0.0588 and multiply by 100 to get percentage. $0.0588 \times 100 = 5.88$ and round to the number of significant figures you need- in this case two significant figures gives **-5.9 % change**.

(Look up rules for significant figures. In short when multiplying or dividing use the smallest number of digits for any value in the set. For addition and subtraction use the least accurate number).

Now if I wanted to compare two racers in a mile run, I would want the % difference in the two times.

B. **Percentage different** would be the same numerator of 0.5. The denominator is now the average of the two values. So add the values- $8.5 + 8.0 = 16.5$. There are two values so $16.5 / 2 = 8.25$ min.

Now 0.50 divided by 8.25 equals 0.0606 or 6.06% or **6.1% different** with two significant figures. In this case, the percentage difference is greater than the percent change but only by a little. Rounding down for numbers 0-4 and round up for 5-9. See other sources for more information on significant figures.

Please Note: When using time, you must always convert seconds into hundredths of a minute if the final expression is in minutes. The units will not change the answer for percentage difference. If we were to use seconds for the same calculations:

$8 \times 60 = 480$, and $8 \times 60 + 30$ seconds = 510. Divide by the original- 510 you get $30 / 510 = 5.8\%$

What about if you were measuring a value that increases with training.

Say I could do 21 push-ups before training and 30 after. So after- before = $30 - 21 = 9$

Now, I divide by before or 21. Now, $9 / 21 = 0.42857$ so rounded to 2 sig figs à 43%. If I was comparing two individuals, I would use the same difference or 9. But now $21 + 30 = 51$,

Now divide by 2, you get 25.5. Final calculation is $9 / 25.5 = .3529$ or 35%. Note the percent change is larger than the percent different here because 25.5 is larger than 21.

Part B: Diffusion- Temperature and Density/Concentration Effects

Chemistry is literally the properties and interactions of molecules with one and another. Molecules will move or be transported in many different ways. One of the critical processes in the human body, as well as all living creatures, is diffusion. There are two main types of diffusion- **simple and facilitated**. **Simple diffusion** can happen anywhere, but it often takes place across some membrane. **Facilitated diffusion** does require a membrane that has a protein channel or carrier to aid the diffusion.

In diffusion, the particles will move from high concentration to low concentration. It will continue to occur until an equilibrium has occurred between the two sides of the membrane or within a given compartment. **Equilibrium** is noticed when the forward and

reverse movement is equal.

I. The rate of diffusion can be altered by several factors such as temperature, pressure, the viscosity of the media, the concentration differences. If is across a membrane, the surface area, membrane thickness, and permeability to that molecule or substance will be factors. **The first part** of this experiment will use 3 temperatures of water and food coloring.

A. First you will need 3 clear glasses of water. Tap water is fine.

B. Whatever amount of water you have in each glass (about 3/4th full) make sure all glasses have about the same amount. Roughly 300 milliliters is fine.

C. You will need to heat the water to almost boiling, have another glass in the freezer for about 10-15 minutes, and have the third just sitting out.

D. Add about 5 drops of food coloring to each glass as quickly as possible. If it takes more than 5 seconds to add the food coloring record this difference and take it into account. Be sure not to disturb the glasses or stir the water, which will cause the water to mix with the food coloring.

E. Record the start time.

F. Record the time of each temperature to almost fully disperse (spread fully and evenly).

II. **The second part of this experiment** will look at the difference between 3 waters with varying amounts (concentrations) of sugar in them. By adding more sugar, you are increasing the density and in this example the viscosity of the solution. The term viscosity refers to the internal resistance of a solution to change in shape or how substance flows. High viscosities will not flow easily, and low viscosities will flow easily. Density is the weight per volume. The density of pure water is 1 gram per milliliter. Adding sugar will increase it above 1 gram/ml. The conditions here are none, a moderate amount (5 teaspoons), and a large amount (10 teaspoons). The importance here is to see a difference between the conditions.

A. Again, fill all glasses to the same level you did in the first experiment (about 500 mls.).

B. This time all glasses will have water at room temperature.

C. Add 5 heaping teaspoons of sugar to the second glass and stir thoroughly to wear almost no sugar is visible. Salt may be used instead of sugar as well.

D. Add 10 heaping teaspoons to the third glass and mix thoroughly again. If you are not getting almost complete dissolution of the sugar add more water to all glasses and stir the 2nd and 3rd.

E. Add the food coloring again and note the time or start the stopwatch (on most smart phones).

F. Record the times to fully dissociate again.

Section 1- Worksheet 1:

Table 1: Effect of Temperature on Diffusion

Temperature	Start time	Finish time	Total diffusion time	% Difference
Hot				
Room				
Cold				

*Note: the shortest diffusion will have no % difference. Use- (longer – shorter)/shorter

Table 2: Effect of Concentration on Diffusion

Concentration	Start time	Finish time	Total diffusion time	% Difference
No sugar				
5 teaspoons				
10 teaspoons				

Section 1- Questions

1. Which temperature was the first to diffuse or dissociate? Which was last?
2. What was the % difference between conditions?
3. Can you explain why this was the result?
4. What caused the differences in diffusion?

In the second experiment:

5. What happened to the density of water as we added more sugar or salt?
6. Does the density of the water increase with more sugar or salt in it?
7. How did density affect the diffusion rate?
8. If we had a cell phospholipid bilayer membrane, would a lipid soluble or water-soluble molecule diffuse through more quickly or more easily? Why? (look it up)

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1.2: Part B- Percentage different



Working on it. Stay tuned

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1.3: Part 2- Diffusion- Temperature and Density/Concentration Effects



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1.4: Section 1- Worksheet 1



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1.5: Part C- Acids and Bases in your Home and Foods



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CHAPTER OVERVIEW

2: The Cell and Division of Labor

[2.1: Part A- Relate your bodily organs to an organelle](#)

[2.2: Part B- Domestic or Commercial Organization](#)

[2.3: Worksheet- Tables for Part A and Part B](#)

Section 2: The Cell and Division of Labor

Specialized Functions Working Synergically

In a cell, there are many organelles that reside in close proximity and perform very specific duties. The concepts of division of labor has been around since the beginning of time and it was adopted by Henry Ford when designing the production line in making cars. Each group performed a specific task that they became very good at and then the car was passed down to the next specialty group until the final product was complete and functional car.

Functional Analogies to a Cell

In each of our cells when have organelles. These organelles are analogous to or our organs. In both cases specialized compartments perform a specific duty that it is equipped to do and very efficient at it. Bringing it up a step from there, human from “organizations” which have specific people who perform specialized duties that synergistically fit into the overall function of that organization. The term organized came from this derivation. When we section things off efficiently- we are “organ-ized”.

Relate your home or the company you work for to a cell in naming specific duties or functions carried out. For example, the kitchen is used for the storage, preparation, and disposal of food. This may be similar to endocytosis and exocytosis, or perhaps it is similar to a Golgi Apparatus in packaging components for transport. or even your own body to the various

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2.1: Part A- Relate your bodily organs to an organelle

Part A: Relate your bodily organs to an organelle in the eukaryotic animal cell. For example, the nucleus is "in charge" of making decisions on what goes on in the cell. It is protected by a nuclear envelope, and it dictates the "orders" for most all operations in the cell. The nucleus of the cell gives instructions to other organelles like ribosomes to make proteins or maybe to a Golgi apparatus to send a vesicle somewhere. **What body organ do we have that does something like this?** You probably guessed it- the brain. It also dictates the operations of the body, both conscious and unconscious, and it is protected by a blood brain barrier. This would be a good analogy.

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2.2: Part B- Domestic or Commercial Organization

Part B: Domestic or Commercial Organization

Option 2a: Your house has special rooms equipped with special devices or equipment to accomplish a given purpose. For example, to live we must eat, sleep, clean ourselves, maintain our hair, nails, teeth, skin, relax, learn, socialize etc. What rooms in the house are designated for each? What equipment helps accomplish this. A phagocyte must destroy and dispose of old cells and waste. Does our garbage disposal and trash can serve a similar purpose? Yes. Continue this analogy in your house or apartment.

Option 2b: In a company, depending on what it does or how big it is has various departments or personnel which perform specific functions needed for the company to accomplish its overall function. Some executives might include a CEO, CFO, COO, Chief Science Officer, Chief Technology Officer, and people in sales, accounting, promotion, IT, etc. State the overall function of your company then mention what a department or person does and how it fits in to the overall goal/function of the company.

Make a table with the department name as a column, the components of that department, and what it does as a third column make work well. You may just write it out or form a flow chart.

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2.3: Worksheet- Tables for Part A and Part B

Section 2- Part A- There are no wrong answers, but some logic and knowledge should be applied.

Organelle	Human Organ	Functional Correlation
Nucleus	Brain	Both are responsive to internal changes & in charge of most functions (like a command center).
Nuclear Envelope		
Smooth Endoplasmic Reticulum		
Rough Endoplasmic Reticulum		
Golgi Apparatus		
Lysosome		
Peroxisome		
Microtubules/ Microfilaments		
Mitochondria		
Centrioles		
Ribosome		
Cytoskeleton		
Centrioles		

Section 2- Part B

Region room or appliance or utility in home	Organ or System, or purpose in life	Functional Correlation
Kitchen	Digestive	Intake of food, processing it for consumption or absorption, storage of excess food, and disposal of waste food.
Dining room/area		
Living room/area		
Bathroom (full) incl bath		
Bedroom		
Study/ office	Brain	Information is taken in, processed, and utilized
Garage	Muscles	Transport items (car), storage of protein (stuff)
Refrigerator/ Pantry		
Washing machines		
HVAC- Heat/ AC		
Alarm System	Immune	
Plumbing system		
Garbage disposal/Trash		

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CHAPTER OVERVIEW

3: Anthropometrics

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SECTION OVERVIEW

3.1: Part A- Body Composition Analysis Case Study

3.1.1: Part A1. Calculate your BMI- body mass index

3.1.2: Part A2- Ideal Body Weight (IBW) Guides

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3.1.1: Part A1. Calculate your BMI- body mass index

Part A: Body Composition Analysis Case Study

The term anthropometrics literally means measures of the human body. Often anthropometry is applied to ergonomics or measuring the human body to combine and align it with physical structures like a desk, chair, and computer screen. In this section we will look at body composition in several ways.

The human body consists of various components. These components are grouped into common properties and functions known as tissues. The study of the tissues is **histology**. There are four primary types of tissues in the body:

- 1) Nervous- the brain, nerves, and neurons;
- 2) Muscle- skeletal, cardiac, and smooth;
- 3) Connective tissue- which includes cartilaginous tissues such as tendon, ligaments, and joint components, as well as adipose, blood, and bone cells
- 4) Epithelial- which make up the coverings of internal and external surfaces.

The various tissues in our body make up organs, which are parts of organ systems, which make up the complete human or organism. The mass of humans or body composition is divided into two categories- *lean body mass* (LBM) and *non-lean body mass* or *fat mass*. The LBM includes bones, joints, organs and most of all body water. The human body varies greatly with body water, but in general is it 50-65% of the total weight. Women generally carry 5-10% more body fat than men, thus have a lower percentage of their weight as water.

Often the amount of fat is commonly related to the total body weight, which is assumed in the body mass index (BMI) to be fat weight. This is not always the case, especially with muscular athletes. Also, circumference measures are commonly used to estimate body composition. In general, the bigger the circumference the more fat is assumed. Again, this is not always the case!

There are many ways to estimate or measure the **body composition** of someone- without special instruments. Each method has its strengths and weaknesses in terms of accuracy vs expense or invasiveness. Some methods require specific instruments like calipers, or impedance machines, while others do not. 

The most recognized measure is the easiest to perform- the body mass index. Using the body mass index (BMI) is the quickest, easiest, and likely the most inaccurate in determining fat content. Body weight does not distinguish between muscle or fat and therefore muscular people will be overweight or even obese, despite having a very low body fat percentage. In addition, wide framed people will be considered “fat” because of lower height versus weight ratio. It also does not distinguish between visceral or sub-cutaneous body fat. Likewise, someone’s circumference measures could be due to muscle not fat and a wide framed person will have greater circumferences regardless of their body fat.

Part A1. Calculate your BMI- body mass index

Category	BMI range - kg/m ²
Severe Thinness	< 16
Moderate Thinness	16 - 17
Mild Thinness	17 - 18.5
Normal	18.5 - 25
Overweight	25 - 30
Obese Class I	30 - 35
Obese Class II	35 - 40

BMI is the weight in kilograms divided by the height in meters squared. Thus, you take your body weight in kilograms, then divide it by your height in meters (or centimeters divided by 100) and divided by the denominator again. Kg/m^2 or $\text{Kg}/(\text{cm}/100)^2$

Using English units:

703*wt (lbs)/ ht (in.), then divide by your ht (in) again. This is because it should be squared. There are many calculators for this as well. This was used by insurance companies originally for health risk thus insurance premium. It is a crude, but easy, gauge of body composition. A lot of research and epidemiologic studies (CDC) use this as the primary measure. The U.S. is currently (2020) at 42% of the population being obese or over 30 on the BMI, and 73.6% are overweight. Thus, almost 3 out of 4 U.S. people are over 25 on the BMI. This figure does not directly relate to the health of the U.S., but it is a strong indication of our country getting fatter.

If I am 176 lbs and 5 feet 10 inches, I am 70 inches tall so- $703*176 = 123,728$, and $70*70 = 4900$, so $123,728/4900 = 25.25$ (just over the normal range- very low overweight range).

<https://www.calculator.net/bmi-calculator.html>

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3.1.2: Part A2- Ideal Body Weight (IBW) Guides

Part A2: Ideal Body Weight (IBW) Guides

Ideal body weight has the same weakness as body mass index. You have no idea what form the weight comes in or its location. The guides are: A man who stands 5 feet 10 inches would have

IBW = 106 (for the first 5 ft) + (10 X 6) (6 lbs. per inch after)= 166 pounds

And for a woman who stands 5 feet 8 inches:

IBW = 100 (for the first 5 ft)+ (8 X 5) (5 lbs. per inch after)= 140 pounds

If someone is large framed, they should have an IBW 10% higher than the standard formula. If they are thin framed about 10% lower. Thus, a large-framed man using the above example would be about 182-183 lbs. and a woman with a wide framed would be about 154 lbs.

There is another easy-to-use formula for ideal body weight that lets you pick the BMI you are shooting for. Some thin people might choose 20, muscular or medium framed may choose 25, and someone who is quite obese and wanting to get to the edge of that category may choose 30. Let use an example for the same 5'10" man who wants to get to 25 BMI (upper normal). The magic number is 5.

- a) For the first 5 feet you will multiply the **desired BMI (25) times 5= 125.**
- b) For every inch after 5 feet, you will take the desired BMI (25) and divide by 5- thus 5 lbs/inch.
- c) For a 5' 10" that would be **10 inches * 5= 50**, so the total is 125 + 50= **175 as an IBW.**

 Body Mass Index - Houston Weightloss Clinic

Figure 1X: The chart shows height in inches or centimeters (y-axis) vs. the weight in pounds or kilograms (x-axis). The intersection number represents your BMI and the color represents your category. See legend for details.

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SECTION OVERVIEW

3.2: Part B- Circumference Measures

Part B- Circumference Measures

To make an accurate circumference measure 3 main criteria should be maintained.

1. The measure should not be taken by oneself, but it can be. (In this circumstance it is fine.)
2. The measuring tape should not be too tight or too loose (firm but not binding). You should not see much of any indentation in the skin.
3. The measure needs to be taken at the appropriate location on the body. You should round to the nearest quarter inch. (Please see other formula or convert for metric measures).

Please note that the following circumferences are not the ones commonly made on athletes or training subjects to show muscle growth. Shoulders, chest, arms, sometimes forearms, quads and calves are commonly measured to indicate muscle growth (hypertrophy). A shoulder to waist ratio in men and chest to waist to hip ratio in women are used to indicate physique qualities. Also note, that when someone notices their clothes are looser or someone has gone down a size, chances are you have lost body fat!

3.2.1: Part B1- Waist circumference

3.2.2: Part B2- Waist to Height Ratio

3.2.3: Part B3- Waist to Hip Ratios (WHR)

3.2.4: Part B4- The U.S. Navy body fat estimation formula

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3.2.1: Part B1- Waist circumference

[Part B1: Waist circumference](#)- This is more limiting because the relative size of the individual is not considered. Guidelines of a waist circumference (in.) of 35” for women, and 40” for men is the cut-off point for low vs high risk of metabolic diseases. This cut off suggests “no middle ground” which is not uncommon for many medically related criteria. Waist circumference predicts cardiovascular disease risk better than BMIs.

 Waist-to-hip Ratio

Figure 2x: This chart displays the cardiovascular disease risk category vs the waist circumference in cm or in. for males and females. Height is not considered in this measure.

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3.2.2: Part B2- Waist to Height Ratio

Part B2: Waist to Height Ratio- This is a great indicator of metabolic syndrome risk. The waist should be less than half of one's height. This takes into consideration a larger person who would obviously have a larger waist. If someone 5'10" (70 in) had a waist measure of 32 then $32/70 = .46$ (healthy). However, if that same person had a 41-inch waist circumference they would be $>.58$ (obese). If the same 41-inch waist was on someone 6'10" or 80 in. then they have a 0.51 ratio and are healthy.

Female	Male	Category
<0.35	<0.35	Abnormally thin
.35-.42	.35-.43	Thin
.42-.46	.43-.46	Slender & Healthy
.46-.49	.46-.53	Healthy
.49-.54	.53-.58	Overweight
.54-.58	.58-.63	Obese
>0.58	>0.63	Highly Obese

Figure 3x: This chart is the ratio of the waist circumference to the height. The measurement unit does not matter but the ratio does. Thus, height is considered in this measure thus a more accurate assessment than waist circumference alone.

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3.2.3: Part B3- Waist to Hip Ratios (WHR)

Part B3: Waist to Hip Ratios (WHR)- Like the Waist to Height ratio, the waist to hip ratio is used to estimate body composition and obesity. Unfortunately, individual variability in fat distribution can throw this measure off. If someone has a large waist and a very large hip measurement (large gluteals) then the ratio will be low and indicate low body fat or CVD risk. Likewise, if someone is thin, but has a small hip measurement they will be overestimated in risk factor. In general, the ratings below are applied to the WHR (Bray & Gray, 1988):

Gender	Excellent	Good	Average	At Risk
Male	<0.85	.85-.89	.90-.95	≥ 0.95
Female	>0.75	.75-.79	.80-.85	≥ 0.86

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3.2.4: Part B4- The U.S. Navy body fat estimation formula

Part B4: The U.S. Navy body fat estimation formula- is an easy to use, moderately accurate measure of (% body fat) body composition. It uses 2 circumference measures for men and three for women. Because using a *log of 10* is difficult for many and some calculators don't have it- calculator sites are given.

<https://www.omnicalculator.com/health/navy-body-fat>

<https://www.calculator.net/body-fat-calculator.html>

Circumferences to determine body composition (U.S. Navy formula).

- 1) **Neck base-** lowest point above trapezius- just below the laryngeal prominence (Adam's apple).
- 2) **Waist-** narrowest part above iliac crest. For most males it is at the umbilical, for female is varies
- 3) **Hip-** with feet together at the widest portion of the gluteals. It is usually at the lateral femoral condyle (the boney point on hip). *Only women need this in the US Navy formula.*

· Men: $BF (\%) = 86.010 \times \log_{10} (\text{abdomen} - \text{neck}) - 70.041 \times \log_{10} (\text{height}) + 36.76 (\text{inches})$

· Women: $BF (\%) = 163.205 \times \log_{10} (\text{waist} + \text{hip} - \text{neck}) - 97.684 \times \log_{10} (\text{height}) - 78.387$

So here are the steps to calculate %BF- turn your iPhone sideways with the calculator app

A. Figure the number out- for example abdomen- neck. If I had 31 inches at waist (the umbilical- exhaled), and 17 inches for my neck (base of neck above trapezius), then I would have 14.

B. Have 14 entered, then hit **log10 button**- you should get 1.146 if you used 14

C. Multiple by 86.010- you should get 98.578 if you used my numbers

D. Do the same for height * log 10- if I used 70 it would be 1.845,

E. then multiply that by 70.041= 129.226

F. Subtract 98.578 from 129.226 = - 30.648

G. Add 36.76 to -30.648 = 6.112 or 6.1% body fat

Do the same for the female formula but you would take waist and hips added and subtract the neck to get the first number. Female body fats are generally 7-10% higher than the respective male value. The chart from the *American Council on Exercise (ACE)* is intended for young (<30 yo) people.

 How To Interpret Your Body Fat Test - Invictus Fitness

 Pin on body fat percentage chart

Figure 4x: The chart above show the different ages from top to bottom and the number in the cell is the individual's % body fat. The color category is listed below that color. The different genders each have their own table here.

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3.3: Part C- Body Frame Estimations



Part C: Body Frame Estimations

A. A fast way to get a general idea of your frame is taking your middle finger and thumb wrapped around your wrist in the boney part. If your fingers overlap with a finger nail- you are thin framed, if they touch you are probably mid-sized, and if they barely touch or do not touch at all you are possibly wide framed.

B. A better estimation is to use your thumb and index finger on each side of your elbow when it is bent 90 degrees. Put your finger and thumb on a ruler immediately after. If you move your finger, repeat the measurement. Use the inside surface of the thumb and index finger to figure out the breadth of the elbow.

C. The chart (right) is for medium frame. So if you are a male 5' 9" or 69 inches tall and your wrist breadth was 2 ½ inches you would be thin framed, and above 3" you would be wide framed.

D. **Wrist circumference** is likely an easier method. Get a tape measure or string and find your wrist circumference (firm not binding).

Wrist circumference women:

- Height under 5'2"
- Small = wrist size less than 5.5"
- Medium = wrist 5.5" to 5.75"
- Large = wrist over 5.75"
- Height 5'2" to 5' 5"
- Small = wrist size less than 6"
- Medium = wrist 6" to 6.25"
- Large = wrist over 6.25"
- Height over 5' 5"
- Small = wrist size less than 6.25"
- Medium = wrist 6.25" to 6.5"
- Large = wrist over 6.5"

Wrist circumference men:

- Height over 5' 5"
- Small = wrist size 5.5" to 6.5"
- Medium = wrist 6.5" to 7.5"
- Large = wrist over 7.5"

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3.4: Section 3 Work Sheet for Body Composition

Section 3 Work Sheet for Body Composition

- A. Body Weight: _____(lbs)
- B. Height: _____ (in.)
- C. Waist circumference: _____(in.)
- D. Hip circumference: _____ (in)

For Part A-1 take: A multiple it by 703, then divide by B, and divide by B again.

For Part B-1 use C. Greater or less than 40" (102 cm) male, greater or less than 35" (89 cm)?

For Part B-4 use C divided by B. Is it less than $\frac{1}{2}$?

Section 3 Questions

Questions for Part A

1. What was your BMI? A1-
2. What category were you?
3. Does this make sense to you or was it "wake up call"?
4. Are you in the range for your ideal body weight? A2
5. Do you believe your muscle mass or body frame threw off the estimation category?

Questions for Part B

1. If you are a male, is your waist over 40 inches? If female, are you over 35 inches? B1
2. Was your waist circumference more than half your height? B2
3. Why do you think "belly fat" might be more dangerous than other fat locations?
4. Look at the scales for Waist to Ht ratio where they distinguished slender and healthy vs. thin. In the BMI ratings, thin vs. very thin. Do you think being really thin is healthy? Why or why not?
5. Why is Waist to Hip Ratio not useful for many people? What could skew it? B3
6. Using the U.S. Navy body fat % formula- what was your body fat %? B4
7. What category or color did you fit into using the bodyfatcharts.com chart?
8. Why is the neck measurement used for both genders? What does it approximate?
9. Why do you think hip circumference used for women and not men?
10. Why is shoulder to waist measure used for male physique competitors? Is your body fat % and your BMI matched up with their categories?

Questions for Part C

1. Which frame size were you? Do you agree with it?
2. Did the rough estimate of fingers touching agree with elbow or wrist measures or both?
3. Why is wrist circumference or elbow breadth used? What is generally not located in those spots?
4. If you were wide framed and added 10% to ideal body weight calculation, did it bring the estimate to a more reasonable number?

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CHAPTER OVERVIEW

4: Metabolism and Calorie Burn

- 4.1: Part A- Calculate your RMR or BMR-
- 4.2: Part B. Calculating RMR based off of Lean Body Mass (LBM)
- 4.3: Part C. Total Daily Energy Expenditure (TDEE)
 - 4.3.1: Using the Activity Factor
 - 4.3.2: Using Institute of Medicine Formula
- 4.4: Part D- Using METs- Metabolic Equivalent Units- to calculate RMR
- 4.5: Part E- Using the “Compendium of Physical Activity”
- 4.6: Section 4- Worksheet
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4.1: Part A- Calculate your RMR or BMR-

Section 4: Metabolism and Calorie Burn

As mentioned in the beginning of this manual, there are close relationships between certain terms or physiological measures. We just looked at body composition using several different measures. In general, the bigger you are (weight) the more calories you will burn at rest. However, the more muscle you have on your frame will also raise your resting metabolic rate for a given weight. So a 154 lb. or 70 kg person with only 10% body fat will burn more calories than another 154 lb. person with 20% body fat. Likewise what you eat can slightly alter your metabolism and it definitely can affect your body composition.

Part A: Resting and Exercise Metabolic Rate

The reason someone would want to estimate their metabolic rate would be to understand how many calories they should consume. While there can be great variability in resting metabolic rates (RMR) between similar individuals and even within the individual on a given day, it is a relatively stable measure for most. The number of calories someone burns (expends in catabolism) at rest (RMR) is dependent on their gender, age, size both in height and weight (or body surface area) and on how muscular the person is.

The mentioned variables will only influence how many calories someone expends at rest in a thermoneutral environment. If it is cold, the thyroid gland is activated to make sure the individual stays at the standard 37 Celsius set point. If the person is quite active during the day, this will also cause more calories to be used.

Activity comes in the form of daily living activities, and structured exercise or physical activity (**PA**). The first term is known as *non-exercise activity thermogenesis* or **NEAT**. Anything that is not eating, sleeping or exercise- is **NEAT**. When we eat, we actually burn more calories to digest and absorb the food. This is called the thermic effect of food or TEF. Interestingly, some foods require more “work” or energy than other foods. For most people this factor is not relevant.

Finally, there is physical activity or structured exercise. The harder someone is exercising the higher the intensity which also indicates the number of calories burnt per unit time. Physiologists can define different activities in terms of **METS** or *metabolic equivalent units*. At rest someone is at 1 MET. The MET unit is convenient because based on the person’s weight in kilograms and the type and intensity of the exercise, the caloric burn can be calculated. This project will use the compendium of physical activity to allow you to see how many METS certain activities are.

TDEE (Total Daily Energy Expenditure) = RMR + NEAT + TEF + PA or = RMR * Activity Factor (estimated)

There are several ways to determine your *metabolic rate* or the calories you consume. The formulas fall into two main categories- a) **basal metabolic rate (BMR)** or b) **resting- metabolic rate (RMR)**. The BMR is almost impossible to accurately measure. You have to be fasted for 12 hours, rested for a couple, and be in a thermoneutral environment. The “actual” RMR is relatively easy to measure but equipment that measures oxygen and carbon dioxide input and output is needed (indirect calorimetry). Also, the actual RMR can vary considerably day to day, depending on several factors including recovery from exercise status and menstrual cycles.

In this section You are going to use different formulas to do the following five parts:

- 1) Estimate your BMR or RMR using two commonly used formulas.
- 2) Estimate your RMR using two lean body mass (LBM) body composition-based formulas.
- 3) Using the two estimates you found in #1, you will calculate your total daily energy expenditure (TDEE) by using the **activity factor table**. You will also use the *Institute of Medicine EER* formula.
- 4) You will estimate your RMR using the MET formula and your body weight. Because this measures calories per hour and there are 24 hrs in a day, you will multiple your weight (kgs) by 24.
- 5) You will then calculate your energy expenditure for a low-level activity and a high level activity. You must look these up in the *Compendium of Physical Activity*.

https://youtu.be/LKZZrJl_NI

<https://youtu.be/0Ifel5ihJTQ>



Part A: Calculate your RMR or BMR- all units are metric and final value is kcals per day.

1. modified Harris Benedict formula,

Male: $88.4 + (13.4 \times \text{Wt in kgs}) + (4.8 \times \text{ht in cm.}) - (5.68 \times \text{age in yrs})$

Female: $447.6 + (9.25 \times \text{wt in kgs}) + (3.10 \times \text{ht in cm}) - (4.33 \times \text{age in yrs})$

2. the Mifflin- St.Joer

Male: $(9.99 \times \text{wt in kgs}) + (6.25 \times \text{height in cm}) - (4.92 \times \text{age}) + 5$

Female: same formula but instead of adding 5, subtract 161. Thus, a 166 kcal difference

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4.2: Part B. Calculating RMR based off of Lean Body Mass (LBM)

Part B. Calculating RMR based off of Lean Body Mass (LBM)

Since lean body tissue is more active than fat tissue, simply using body weight is not an accurate means of estimating metabolic rate for a more muscular person. This is similar to body mass index not being a good gauge of body composition in a heavily muscular person. Use the U.S. Navy formula to estimate LBM.

To use the Katch McArdle or Cunningham formulas you must know someone's lean body mass. To calculate lean body mass (LBM) you must know your body fat %. In another section we used the U.S. Navy formula to estimate % body fat. If you know your body fat % then $\text{total weight} - (\text{total wt} \times \text{body fat \%}) = \text{LBM}$. In example, if you are 80 kilograms and 20% body fat it would be $80 - (80 \times .2) = 64$ kg of lean body mass. An easy way is also to use $(1 - (\%BF) \text{ or } .2) \times \text{body weight}$.

1. Katch-McArdle lean body mass RMR calculation,

$\text{BMR} = 370 + (21.6 \times \text{LBM kg})$ or $370 + (9.82 \times \text{LBM in lbs})$

2. Cunningham formula also LBM- generally a higher estimation but more accurate for muscular athletes **$500 + (22 \times \text{kg of LBM})$**

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SECTION OVERVIEW

4.3: Part C. Total Daily Energy Expenditure (TDEE)

Part C. Total Daily Energy Expenditure (TDEE)

 Activity Factor Table- Five rows with varying levels of activity per day- ranging from sedentary to extremely active from top to bottom. The columns include amount of exercise, description, and the multiplication factor for the BMR. 1.2 times BMR for sedentary and 1.9 for very active.

Your BMR/RMR is only one part of your total daily energy expenditure. Experts have developed the **activity factor**- to estimate the TDEE for an individual based on their estimated activity level on a daily basis. In general, adult woman who are lightly to moderately active burn about 2000 kcal/day, and men come in at about 2500 kcal/day. This varies dramatically with the size and activity of the individual. Young (16-26 yr), larger active males may burn 4000 kcal/d and females about 3500 kcal/day.

Use the RMR values you got for parts A1 and A2 and multiply by the activity factor in the table below. Compare it the value in part A5. You will have to judge where you fit in with your activity levels- be honest.

1. **Institute of Medicine (IOM) TDEE formula (2005)** (see link below)- with height and weight and PAL will estimate you total daily energy expenditure. Use the formula best suited for you or simply use the calculator provided in the links below to estimate TDEE which they call **EER**.

<https://globalrph.com/medcalcs/estimated-energy-requirement-eer-equation/>

[EER Calculator - Estimated Energy Requirement \(omnicalculator.com\)](#)

EER- **Estimated Energy Requirement** is the same as the **total daily energy expenditure (TDEE)**. It uses physical activity levels (PAL) with- sedentary is 1.0-1.39, low active 1.4-1.59, active 1.6-1.89, and highly active- 1.9-2.5. It uses 0, 2.2, 7.3, and 16.7 miles of walking per day for each category, respectively.

Males >19 yrs- $EER = 662 - (9.53 * Age[yr]) + PA * ((15.91 * Weight[kg]) + (539.6 * Height[m]))$

Females >19 yrs- $EER = 354 - (6.91 * Age[yr]) + PA * ((9.36 * Weight[kg]) + (726 * Height[m]))$

Many calculators are available for the Institute of Medicine formula. The PA factor is multiplied by the sum of the weight and height factors combined.

4.3.1: Using the Activity Factor

4.3.2: Using Institute of Medicine Formula

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4.3.1: Using the Activity Factor

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4.3.2: Using Institute of Medicine Formula

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4.4: Part D- Using METs- Metabolic Equivalent Units- to calculate RMR

Part D: Using METs- Metabolic Equivalent Units- to calculate RMR

A very useful unit for converting your activity to calories or to oxygen consumption is the *metabolic equivalent unit*. This is known as a MET. A MET is based on your activity level and your body weight in kilograms. At rest it is one. The unit of a MET is a) 1 KCal/Kg/Hr or b) 3.5ml/kg/min of oxygen consumption. The harder you exercise or exert the higher the MET level. Five categories I have developed are below. I have assigned RPE levels to give you a better idea of intensity.

- Light activity 1.5-3 METS (RPE 1-3)
- Moderate 3-6 METS (RPE 3-5)
- Vigorous 6-9 METS (RPE 5-7)
- Intense 9-12 METS (RPE 7-9)
- Very Intense >12 (RPE 9-10)

(very intense could be a category for athletes to signify anaerobic- this is above 12 METS)

1. Calculate your RMR by 1kcal/kg/hr- (use a- see example below) for an hour

- remember 2.2 lbs = kg or 1 lb= 0.45kg

Take your body weight (kgs) * 24 (hrs in a day) to get kilocalories in a day- with no additional activity (thus an RMR). So, if you weighed 176 lbs or 80 kg- and you were at total rest (1 MET) all day for an entire day, the estimation would be $80 \times 24 = 1920$. Compare this to the first two equations- the Harris Benedict and Mifflin- St Jeor. Use the % difference formula in Section 1.

2. Calculate the amount of oxygen you consume in a day.

- Remember, it is per minute so multiple by 60. Give your answer in mls and in liters.

Using the online calculator with the variables plugged in: <https://www.calculator.net/bmr-calculator.html>- what do you get? How does it compare to the other calculations?

Part E: Using “Compendium of Physical Activity” for an easy and an intense activity

<https://pacompendium.com/>

3. Calculate your RMR for a two activities- Use **METS x 3.5 x BW (kg) / 200 = Kcal/min**, please note this is per minute so if you were exercising at 8 METS for 25 minutes how many calories would you burn if you weighed 65 kilos or 143 lbs.

$8 \times 3.5 \times 65 = 1820$, divided by 200= $9.1 \text{ kcal/min} \times 25 \text{ min} = 227.5 \text{ kcals}$.

How do you know how many METS a given activity is- look it up in part E

A) Vigorous up to very intense activity (>6 METS)

B) low intensity (light or moderate) one- watching TV, golf, gaming whatever and calculate the calorie burned for each. You will need to see what the MET level is and **how long you typically do it** and your weight in kgs.

For example, you might run for 20 minutes at 8 METS or you might do computer games for 120 minutes at 2 METs- give me the total calories for you- It will be your weight in kilos x MET level x #hrs you do it.

If I watch TV for 3 hours- 180 min- $1.3 \times 3.5 \times 80 / 200 = 1.82 \text{ kcal/min} (*180) = 328 \text{ kcals}$

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4.5: Part E- Using the “Compendium of Physical Activity”

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4.6: Section 4- Worksheet

Section 4: Worksheet

1) 2 different RMR/BMR calculations

- Write the modified Harris Benedict formula out
- Put your data into the formula
- Do the calculations and put down your answer with correct units
- Repeat this for the Mifflin-St. Jeor formula
- What is the percent difference between the two?

2) Two different lean body mass RMR calculations- The Katch McArdle and the Cunningham formulas. In general, the Cunningham will be a high number (overestimate) of your actual RMR. It was developed on muscular athletes. **You will first need to calculate your %BF** -using the U.S. Navy or another way or if you have had it tested then use that.

- Find out your % body fat and multiply it by your total weight to get fat mass.
- Do the math to find out your lean body mass. (total- fat mass= LBM)
- Plug your LBM numbers into the Katch-McArdle and Cunningham formulas
- What are the differences between these two?
- Is the average of the first two or the second two formulas higher?

3) Calculate your TDEE using at least 2 or 3 of the RMR or BMR values you got multiplied by the activity factor. Also calculate the Institute of Medicine value. Compare these

4) Calculate your RMR using the MET units-

- two different formulas given- body weight in
 - $\text{kgs} \times 24$
 - $(3.5 \times \text{kgs} \times 24 \times 60)/200$

5) A high intensity activity- make sure you only put it for the duration you do it- like 20 min.

6) A low intensity activity like watching TV/ computer games for as long as you do it.

Formula	Calculated RMR/BMR	TDEE- Activity Factor * BMR/RMR
Modified Harris-Benedict		
Mifflin-St.Jeor		
Katch-McArdle		
Cunnginham		
Institute of Medicine (EER)	N/A	
METS formula- $\text{kg} \times 24 \text{ hrs}$		
METS- using min. formula		
Average (first 4)		Avg- all 5

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4.7: New Page

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CHAPTER OVERVIEW

5: Nutrition

5.1: Part A- Vegetarianism -Good or Bad- for you and the environment

5.2: Part B- Nutrition Case Study -Using MyPlate.gov

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5.1: Part A- Vegetarianism -Good or Bad- for you and the environment

Part A- Vegetarianism -Good or Bad- for you and the environment

As mentioned in the beginning of this manual, there is a strong relationship between metabolism, body composition, and nutrition. The old adage that a calorie is a calorie is true thermodynamically, but not metabolically. The different types of foods we eat not only provide us with vitamins, minerals, carbohydrates, fats, and proteins, but they also have phytochemicals in them. These plant chemicals not only provide protection and critical functions to plants, but they serve and protect us as well.

The **phytochemicals** are highest in colorful foods because the phytochemicals impart color quite often and even smell in some cases. What you eat has a significant effect on how you physically and mentally "perform" as well as your metabolism. The last statement is likely not a "news flash", but did you know- what you eat also has a very significant impact on the environment?! Many people are leaning toward what is called a "plant-based diet" versus a vegetarian diet. They claim they have more energy and feel healthier. Others have claimed they felt weak and lacked energy. There is no right answer or right diet but there likely is a right food for you. There are some good guidelines if you want to stay healthy, but change is difficult for many and sometimes finding good organically grown food can be expensive and hard to find.

Some of the statistics in this documentary are stunning. But remember, they are meant to be. In other words, documentaries by their very nature are one-sided and can "slant" things in very ingenious ways. [Here is the trailer to the documentary.](#)

<https://gamechangersmovie.com/> (to watch a web-based version)

I want you to see the movie and write down at least 4 points you got out of it that you may have not known, or it confirmed your thinking. It is a long but very entertaining documentary on Netflix (The Game Changers). If you don't have Netflix, then don't worry you can find it on YouTube (link provided).

Here is the follow up- a scientific look at it (counterpoint if you will) from an MD/PhD. [Opposing viewpoint video](#)

After you seen the movie, watch this "counterpoint" or analysis and then say how it influenced your thinking or thoughts on your 4 points. Again, remember there is no right or wrong answers on this. Just your perspective! Please consider both sides of the issue- as a true scientist should!

I personally think going modified vegan would be great for our health and sustainable future. However, I like the flavor and texture of meat (Umami/ savory) and like the protein quality I get from it. Again, please comment on another's thread and this is fine. Again, it needs to be substantial.

Enjoy, Carnivores, Herbivores, and Omnivores alike-

Four Points

- 1.
- 2.
- 3.
- 4.

After the counterpoint video- how do you feel about these points?

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5.2: Part B- Nutrition Case Study -Using MyPlate.gov

Part B- Nutrition Case Study -Using MyPlate.gov

Understanding what food are good for you is not the problem for most of us. Actually, getting those foods into our eating program is more of the issue (see figure below). Also, the accountability you have, or don't have, is often an issue as well. Good guidance on nutrition is also hard to come by, for three reasons.

- 1) Nutritional information changes as more studies and discoveries are made.
- 2) The individual or group delivering the information is naïve or misinformed on nutritional facts.
- 3) There is a profit-motive to the claim they are making. They are trying to sell a supplement.

The United States Department of Agriculture (USDA) has been delivering information to the US citizens for decades now. The methods or programs they have delivered have evolved with time. The use of <https://www.myplate.gov/> has been the plan for a while now. It divides a plate up into the relative portions of each “food group” you should have. The groups now include- fruit, vegetables, grains, protein, and dairy. The website requires you to “register” and then will display various selections. They also have a phone app for those wanting it on their mobile devices.

 A continuum process from left to right starting with knowing what nutrients someone needs to knowing what foods to get them from to getting the foods from a grocer, to preparing a meal with those foods.

The site starts you off with a “What’s on your plate?” quiz. The quiz is relatively short, and it is trying to capture what your current eating plan is like and where you want help. It then offers tips and information to help get that information or develop goals. In this exercise, you should:

- 1) **Register on the website**
- 2) **Take the What’s on your plate? Quiz**
- 3) **Tell me your results (this doesn’t effect your grade). What areas were checked or not?**
- 4) **Fill in the data for get your “My Plate Plan”. It will ask you- age, gender, weight, height and activity level. Be as honest as possible.**
- 5) **Let me know your calorie total for your plan.**
- 6) **Let me know the amount of each group you should have.**
- 7) **Go to MyPlate Kitchen- Go to “View Recipes”- Pick a category- say “breakfast” or “salads”.**
- 8) **Give me the name of two dishes you saw in that category.**
- 9) **Choose one to be in your cookbook- by hitting “my saved recipes”.**
- 10) **Have you ever visited a “Farmer’s Market” in your area? Do they have one close by?**

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CHAPTER OVERVIEW

6: Neurophysiology

6.1: Part A- Neurology- Agility, Balance and Coordination

6.1.1: Balance

6.1.1.1: Static Balance

6.1.1.2: Dynamic Balance

6.1.2: Coordination

6.1.2.1: Hand-Eye Coordination

6.1.2.2: Motoric coordination

6.1.2.3: 4. Perceptual Coordination- The Stroop Test

6.2: Simple and Choice Reaction Time

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SECTION OVERVIEW

6.1: Part A- Neurology- Agility, Balance and Coordination

6.1.1: Balance

6.1.1.1: Static Balance

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6.1.2: Coordination

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6.1.1: Balance

1. Balance

Balance can be assessed many ways. We have both dynamic and static balance, and each requires a unique test. The ability to keep your center of mass over your base of support is the critical factor in balance. People can increase their balance by 1) spreading the center of mass over a wider area, by spreading their arms, 2) lowering their center of mass, which brings it closer to the base of support, or by 3) widening the base of support. A sports car that can take turns very fast have a wide base of support, a low center of gravity and are well balanced throughout the car to enable this feat.

Three main system contribute toward equilibrium or our ability to stay upright.

1. Vision
2. Proprioception- limb position and pressure awareness
3. Vestibular system- Inner ear

By taking away vision or increasing the difficulty for balance we rely on other systems to a larger degree. Reducing our base of support or making things dynamic also decreases the ability to stay balanced. You need to do 4 different stances for 10 seconds- twice each, with eyes open and closed.

Prior to starting- Make sure you are barefoot or sock-footed, and on a hard floor- not carpet.

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6.1.1.1: Static Balance

Static Balance

In the table below, put the amount of time up to 10 seconds you could each position.

Position	Eyes open	Eyes closed
2 ft- normal spread		
Big toe-instep		
Tandem		
One-leg stance		

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6.1.1.2: Dynamic Balance

Dynamic Balance

We performed a tandem walk in three ways for this one. Maxing out would be at least 10 steps. Enter the number of steps you could under each condition.

Condition	Steps
Tandem Walk (TW)	
TW looking up	
TW backwards	
TW eyes closed	

1. Could you stand when looking up and twirling your head? What systems of balance were compromised when you did this?
2. What system(s) needs to “kick in” when you closed your eyes?
3. Do you think yoga or something like this could improve your balance?
4. Do you get seasick? Why do some people get seasick?
5. What systems are involved when someone get seasick? (Look it up)
6. What happened to balance as we progressed from normal stance, to one leg? What changed?
7. What element was added with the tandem walk? What difficulties does TW conditions did you have? Did the TW eyes closed condition feel “comfortable”? Why or why not?
8. What part of the brain is used for balance, coordination, and complex movements?

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SECTION OVERVIEW

6.1.2: Coordination

6.1.2.1: Hand-Eye Coordination

6.1.2.2: Motoric coordination

6.1.2.3: 4. Perceptual Coordination- The Stroop Test

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6.1.2.1: Hand-Eye Coordination

What is coordination? It is actually several things or there are several types. The ability to time the body's reaction with an external stimulus is known as **hand-eye coordination**. The ability to control the speed or pressure of a movement is **kinesthetic coordination**, and the ability to move limbs in different directions simultaneously or at different speeds is **motoric coordination**. Many skills such as juggling would require all three at once. The ability to catch or hit a moving baseball definitely involves hand-eye coordination and large degree of the third one. To hit a golf putt just right to sink it, or bowl a perfect game is likely be due to the second type mentioned.

Instructions: We will test hand eye coordination with a simple tennis ball catch test.

- a) Take a tennis ball against a flat wall (like a garage door or outside wall. Stand 6-7 feet or 2 meters away from the wall.
- b) Record the number of times you can throw the ball underhand from one hand against the wall to the other catching it in 30 seconds.
- c) You are allowed two practice rounds and two trial rounds. Take the best of the trial rounds.

Coordination test- # of tosses completed.

Caught Ball Tosses- 1st trial _____, 2nd trial _____, 3rd trial _____ Did you improve with practice?

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6.1.2.2: Motoric coordination

1. Motoric coordination

Condition 1: Take your left hand to your left ear and your right to your nose. Now extend both arms forward fully and when coming back put your left hand on your nose and your right hand on your ear. Repeat and go back to the starting position. Now go faster and faster until you mess up.

Condition 2: Now start with your left hand on your right ear and your right hand on your nose. Now extend your arms fully forward and come back and switch your hands so your left hand is on your right ear and your right hand is on your nose. Repeat until you mess up- if you have not already!

1. Could you do the cross hands nose and ear touch?

2. What condition was harder the non-crossed or crossed? Guesses why?

Condition 3: This time we will be spinning our fingers together at the level of your stomach. Point your index as to make a number one. Spin both hands clockwise if you were viewing it from your right side. So your finger moves to the top and forward. Stop and spin both hands counterclockwise from your right side. So your finger moves from top and backwards. Now go opposite directions simultaneously.

3. Could you spin your fingers in opposite directions? Why not?

Try the trick of having your fingers meet at the top and then at the bottom.

4. Can you do it now?

Condition 3: Point both hands at shoulder height with the fingers pointing outward and together. Make one hand go in small circles. Stop. Make the other hand go up and down. Not so bad?

Now, do the same thing but the hands are moving those different directions at the same time. Not so easy huh? Now, switch motions for each hand.

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6.1.2.3: 4. Perceptual Coordination- The Stroop Test

4. Perceptual Coordination- The Stroop Test

<https://faculty.washington.edu/chudler/java/ready.html>

Follow directions on this website. Record the two times and the difference between the times.

<https://dictionary.apa.org/stroop-effect>

- a) What do you believe is going on in your brain when you see a color but the word is a different color? If it was naming animals would the interference be the same?
- b) What is interference?
- c) What is congruent and incongruent phenomena mean? How is processing time affected?

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SECTION OVERVIEW

6.2: Simple and Choice Reaction Time

Simple and Choice Reaction Time

When someone reacts to a given stimuli many factors are involved. First, it **is important to distinguish a reflex versus a reaction**. A reflex is a “pre-programmed” or built in response of the nervous system to a given stimuli. There is no processing by the brain but there is some processing in the spinal cord. It is technically an unconscious movement but you are “knocked out” while doing it! Depending on the reflex, it can be a simple monosynaptic reflex, like the knee jerk reflex which will stimulate contraction of an agonist and inhibit an antagonist. The stimulus for the patellar tendon was stretch in the intrafusal fibers of the quadriceps, which causes the subsequent contraction, and thus the foot raises slightly if the person is in a relaxed seated position.

A more complicated reflex, like the crossed-extensor reflex, is the response a nociceptor or pain receptor. If someone stepped on a sharp object with their right foot, a multi-synaptic reflex would initiate not only hamstring contraction, and quadriceps inhibition, but the opposite leg would have quadriceps stimulation and hamstring inhibition. Also, stabilizers up or down the spinal may be initiated. Because there is no “central processing” by the brain, the response is very fast.

A Practiced Reaction- A pre-programmed reaction

Some individuals can perform a given response to a stimulus so often, that the neural pathway for that response is strengthened and thus the speed of the response is increased, and the amount of “thinking” is minimal. Athletes such as boxers or MMA athletes must have this type of “automated reaction” or they will not succeed. Likewise, a baseball player hitting a ball that moving in several planes at once at 90-100 miles per hour, or a football receiver catching a pass while running and avoiding the defender must have amazing reactions and it is because they have practiced it many, many times. Gymnasts must have amazing body awareness as they go twisting and flipping at high speeds and then must “stick a landing”. These performances come from repeated practice under many conditions. The brain does not need to do as much processing when the skill is well rehearsed or literally “ingrained” in the athlete or even the soldier. Correct performance seems to come “naturally”, which couldn’t be further from the truth.

When a choice is entered into the equation, the reaction time, and error will increase. The number of car accidents that occur due to (texting) “pre-occupied drivers” is incredibly high. The statistics on car accidents, and deaths is mind boggling.

- The NHTSA (U.S.- DOT division) claimed 2841 deaths in 2018 due to texting and driving.
- 1.6 million crashes happen each year due to using a cell phone while driving
- 1 out of 4 of the 390,000 injuries happen each year due to texting and driving.
- It is estimated you are 24 times more likely to crash if texting while driving!
- 14% of all fatal car crashes due to texting and the 20–29-year-old group is the highest of these.
- It is estimated 660.000 U.S. drivers use their cell phone while driving.

Work Sheet for Part B

A. Please do this exercise and record your results. Go the following website and follow the instructions.

https://www.psytoolkit.org/lessons/simple_choice_rts.html

Reaction Type	avg time	% Errors
simple		
choice		

B. Finally, use your phone’s stopwatch function. **1st** try to stop the stopwatch at 5 or 10 seconds. How close did you get? Average 5 attempts (i.e. $5.11 - 5 = 0.11$ or 5.05 is 0.05). **2nd** try to start and stop the stopwatch as fast as possible. Again, take the average of 5. Which was smaller the 1st or 2nd exercise? Thoughts?

6.2.1: Worksheet for Reaction Times

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6.2.1: Worksheet for Reaction Times



Working on it. Stay tuned

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6.3: Exercise and the Brain- Discussion

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SECTION OVERVIEW

6.4: Lab for Special Senses

6.4.1: Worksheet for Sensory Physiology- Case Study

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6.4.1: Worksheet for Sensory Physiology- Case Study

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CHAPTER OVERVIEW

7: Muscle Performance

7.1: Part A- Strength- Predicted One-Repetition Maximum

7.2: Part B- Power Test- Vertical Jump and Clap Push Up Test

7.3: Part C- Muscular Endurance- Three Different Calisthenics- Until Fatigue

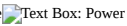
7.4: Part D- Agility Tests

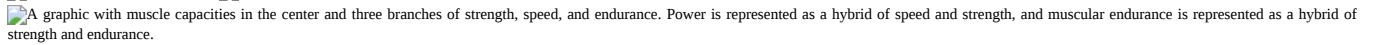
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7.1: Part A- Strength- Predicted One-Repetition Maximum

Part A- Strength- Predicted One-Repetition Maximum

The obsession with human muscle goes back to the beginning of recorded time. Feats of strength were tales of Biblical and Mythical proportions! With Sampson, Goliath, and Hercules topping the charts. The muscles are limited by several factors in reality. Muscles are limited by contractile strength, fuel sources that produce ATP, the calcium that can be supplied the biomechanics of given motions.

 A graphic with muscle capacities in the center and three branches of strength, speed, and endurance. Power is represented as a hybrid of speed and strength, and muscular endurance is represented as a hybrid of strength and endurance.

The main three variables that limit performance are strength, speed, and endurance. Simply put, the amount of weight we can lift once is **strength**, the number of repetitions we can lift a weight is **endurance** and the **speed** with which we can move a limb is speed but with a given weight is actually **power**. We observe these factors in sport all the time. In track and field, the longer someone must run, the slower the average pace will be. If someone was throwing a baseball they would throw it a lot farther than a 16 pound shot put.

In this section we will observe or gauge strength, or the ability to perform a given lift once with a maximal weight. This is known as the one-repetition maximum (1RM) and it indicates the maximum concentric strength of a given set of muscles in a certain movement pattern. As the number of times, you perform a given lift (repetitions) increases, the weight that can be lifted decreases in a predictable manner for most people. This predictable manner has led researchers to develop formulas to predict the 1RM from a given maximal effort with multiple repetitions. For example, if you can do 100 pounds on a bench press ten times then 100 is about 75% of the predicted maximum. So, if you divided 100 by 0.75 you will get 133 as a predicted maximum lift.

The first part of the assignment is to calculate your **1RM prediction** for 3 different lifts in different body locations if possible. Do not use major muscle groups or body areas twice for this lab. So, a hammer curl and a preacher curl would not work because they both emphasis anterior arm muscles.

You must determine your predicted 1 repetition max (1RM) by using 3 different formulas. Three common methods are provided below in the table. You can see the 1, 6, 10, and 12 repetitions are highlighted for a reference. As you can 3 reps is 90%, 6 reps is about 83 or 5/6th of maximum, 10 reps is about 75% or 3/4ths maximum and 12 is about 67% or 2/3rds maximum. In this lab, you will need to do the following:

- 1) Pick a weight that you can only do 10 times or less. Do a warmup set or two with a light weight.
- 2) You need to perform the lift with maximum effort.
- 3) You must give me a 100%, 75% and 67% 1RM value and roughly how many repetitions you could do or what the formula says.
- 4) Repeat this for two other body areas.

Suggested areas include- a) chest, b) anterior arms (biceps), c) posterior arms (triceps), d) upper back- scapular retractors (rhomboids), e) upper back- arm adductors (lats), f) squats- posterior hip, anterior leg, g) leg curls or dead lifts (hamstrings, posterior chain), h) posterior lower leg (gastrocnemius, soleus)

If you are doing 3 body areas, and using 3 different formulas, and getting three different %s of maximum (100, 75, and 67) this is 27 different numbers! A shorter version could have just one formula. You may use the actual formulas to plug in your weight and reps or you may simply divide the weight you used by the percentage of the number of reps you were able to get out. Please realize for the 75% and 67%, are simply multiplying the 100% by .75 and .67 respectively, or taking 3/4ths or 2/3rd s the value and plugging in the appropriate number of repetitions.

Here is an example- If I did a lift with **185 lbs.** on the bench press and got **4 repetitions**. I could either plug it into the formulas for each of the three "Weight Lifted" and "Reps Performed". I can also take the percentage from the table provided. The repetitions must be between 1 and 10. So for the Brzycki formula 4 reps corresponds to 88%. I then divide the weight I did by 0.88. So, $185 / .88 = 210$, or I could do 210 # as my 1RM. Now to calculate my 75% and 67% - $210 \times 75\% = 158$, and $210 \times 67\%$ is 140.7 but round down to get 140, and I should get 10 reps with 75% and about 12 with 67% 1RM.

Estimated Reps at Percent of 1 Repetition Maximum

Repetitions (Reps):		1	2	3	4	5	6	7	8	9	10	11	12	15
%1RM	Brzycki	100	95	90	88	86	83	80	78	76	75	72	70	
	Baeckle	100	95	93	90	87	85	83	80	77	75		67	65
	dos Remedios	100	92	90	87	85	82		75		70		65	60

You must use the Brzycki formula and two other formulas. For your information, there is also a Brzycki formula that has a two entry prediction, thus you have two different weights with different reps.

The following “online calculator” will give you approximate values however, this lab will require you to plug in the numbers into the proper formula and calculate your own result. Many are available on the internet. <https://exrx.net/Calculators/OneRepMax>

Your table may look like this or you can use this table.

Lift	Brzy-100%	Brzy-75%	Brzy-67%	Baeckle-100%	Baeckle-75%	Baeckle-67%	Dos Remedios 100	Dos Remedios 75%	Dos Remedios 67%
Bench									
Lat Pull									
Squat									

In general- Lifters are able to do 100% RM- one time, 75% 10 times, and 67% about 12 times. These generally fall into three different training- categories: strength, hypertrophy, and endurance- respectively. Adding speed of movement to hypertrophy gives power.

Interestingly, the 75% value is used for hypertrophy (building), and 67-50% for endurance training (toning). The training goals of the individual should dictate what “rep range” he or she will use. Often, repetition ranges of:

- 5 and below are for strength (>85% max)
- 6-12 hypertrophy (85-67%)- or muscle building
- 13 and above is endurance (<67%) training- or toning

Understand there is not magical cut off point and different individuals will respond differently to the resistance workouts. Also note, very high repetitions are ineffective in strengthening muscles.

Brzycki, Matt (1998). A Practical Approach To Strength Training. McGraw-Hill.

Baeckle TR, Earle RW, Wathen D (2000). Essentials of Strength Training and Conditioning, 2: 395-425.

dos Remedios R (2007) Men's Health Power Training, Rodale Inc. 23.

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7.2: Part B- Power Test- Vertical Jump and Clap Push Up Test

Part B- Power Test- Vertical Jump and Clap Push Up Test

A second limitation of muscles is the speed of movement with a given load. This is known as power. From the standpoint of most sports, power is probably the most important variable to obtain- meaning it affects performance the most. The ability to bring a bat around fast, or for a running back to run fast and “strong” (not easily tackled), or for a basketball player to jump high are all very important for successful performance in that sport. Many of the track and field events are power events and require specialized training and a lot of it!

As weight gets heavier, the slower someone will move. Interestingly, the last example mentioned, a vertical jump is an easy to perform test and a reliable gauge of **lower body power**. The faster someone can contract their quadriceps, gluteals, and gastrocnemius, the higher they will jump. Because body weight is the resistance, it will strongly influence the jump height. Thus, comparing the differences in jump heights between individuals should be limited but the “calculator” (website) is designed to measure power output. <https://exrx.net/Calculators/VerticalJump>

Lower Body Power

Comparisons within the individual are quite valid, and if someone lost weight but not leg power, it will be revealed with improved jump height. Technique can also influence the height thus the subject should be shown proper technique and allowed 2-3 practice trials. The top height of 3 “test” trials should be used. The testee should be warmed up and minor practice trials should be performed. Note that power is quite limited so strong practice trials may result in a lower actual test result.

Get a piece of chalk- small stick is best. Which ever hand possesses the chalk should be closest to the wall. Generally, the dominant hand is the best choice. The jumper may either: **A)** have both feet about shoulder width apart and squat down swinging the arms back and then forcefully swing the arms forward and jumping and then marking the wall much like hitting a volleyball spike. **B)** Some people may choose to have the feet spread apart a stride length, then quickly step with both feet under them and jump.

Height 1: _____

Height 2: _____

Height 3: _____

Upper body power

One of the main tests is the seated or kneeling medicine ball toss. It is usually with an overhead throw (kneeling) or a push from the chest(seated). For the overhead toss- males use a 3 kg (medicine) ball and females use a 2 kg ball. Unfortunately, there is not as much standardization with it in both weight of the medicine ball and toss technique. The seated push or putt has a 3 kg for males and 1.5 kg for females.

A quick measure could be the plyometric push up (with a clap). If someone can do two claps from the ground with good body position, and hands about shoulder width, they have “very good” power, if a testee get one clap they have good power, and just getting hands off the ground is moderate or fair. The test can be done on an incline as well. Be careful not to hurt the wrists of the testee and have a practice test with pads or pillows underneath the body (not the hands).

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7.3: Part C- Muscular Endurance- Three Different Calisthenics- Until Fatigue

Part C- Muscular Endurance- Three Different Calisthenics- Until Fatigue

The Best (or Worst) of Both Worlds

A third limitation we will be testing is the endurance of a given muscle or repeated contractions with a submaximal resistance. We will recreate the endurance with number of repetitions with a sub-maximal weight (body weight). The other end of the spectrum from strength or power is muscular endurance. This should not be confused with cardiorespiratory fitness like running, cycling, swimming, rowing or hiking.

The ability to perform activities requiring muscular endurance are a hybrid of strength training or cardiorespiratory training. For example, using your body weight (calisthenics) for a given exercise is often done to measure muscular endurance. Speed of movement is not measured in this test but moving too fast or too slow is not going to be optimal. Remember power is speed and tension combined and this is very exhausting to muscles and the joints. Here are a few examples-

Upper body

- Pushups- upper body strength- especially chest, anterior deltoids, and triceps
- Dips- upper body strength- especially lower chest, anterior deltoids, triceps, serratus anterior
- Chin ups or Pull Ups- upper body strength- especially, biceps brachii, brachialis, latissimus dorsi, brachioradialis, and forearm muscles. Pull ups will emphasis certain muscles differently.

Mid Body (Core)

- Planks, Crunches, Sit-ups- mid body, torso, or core fitness

Lower Body

- Squats or squat jumps, lunges, side lunges- lower body- gluteals, quadriceps, core muscles

All (Total) Body

- Burpees or Skaters- total body

Testing Procedures

For muscular endurance testing, the three most important things to remember are:

1. Make sure your form is the same for all three trials
2. Make sure you count correctly
3. Time the rest interval correctly and appropriately.

Say you do push-ups. First determine if you are going to do elevated on a bench or table, or on your knees, or standard on the floor. Make sure to use a pad if on one's knees. You then must choose the rest interval. It should be standardized to 30 or 60 seconds for all exercises. My strong recommendation is 60 seconds which is not much for most people. You must do it with the same form as the original trial. Try to have a helper with timing, otherwise do your best. Legs (lower body) tends to recover better but this is not true for everyone. The rest interval **MUST BE THE SAME** for the second and third trials.

You can also do timed activities if it the whole body. For example count the burpees for 60 seconds, planks for a long as you can, squat repetitions for 1 minute, or squat jumps for 30 seconds. Select a time where you begin getting fatigued but can go a little further. For this lab, 60 seconds rest between sets- is strongly recommended. This will seem like a long time, but if you give maximal effort, it should be fine.

Pick three in different body regions (shown above) and depending on what equipment or facilities you have available. The ones listed above (except chin-ups and dips) can be done without any equipment. We are not testing the number you can do, but rather your fatigue ratio. This means the effort needs to be maximum each time. You cannot hold back on the first set to "save up" for the following sets.

Fatigue Ratio (% change) = (After-Before)/ Before- (it will be a negative number)

So 10 on 1st set, 7 on second would be a 30% decrease. If you did 5 on the third set you would take $7-5$ or 2 and divide by 7 to get 28.6 or 29% decrease. Remember the % decrease compares the trial to the one before it. Some people will have a fast decrease between 1 and 2 and for others it will occur more from trial 2 to 3. For the fun of it look at the difference between the 1st and 3rd set. Which body area had the biggest decrease from 1 to 3?

Exercise	1 st set	2 nd set	3 rd set	Fatigue 1-2	Fatigue 2-3	Fatigue 1-3	Which % bigger 1-2 or 2-3?
Upper-							
Mid-							
Lower/all-							

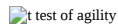
1. Was the fatigue ratio between 1 and 2 larger (%) or was 2 to 3 (%) larger? Why was that?
2. If you regularly trained these exercises what would happen to the fatigue ratios?
3. What would happen to the absolute numbers?
4. If you took a longer break, what would happen to the fatigue ratios? Why?
5. Why do you think a certain body had less fatigue than another? Does this make sense for you?

If you know what the skaters exercise is you can do that for 30 seconds and count the number of laps you do. It is bounding laterally and catching your balance and thrusting back the other way.

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7.4: Part D- Agility Tests

Part D- Agility Tests

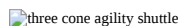


Technically, agility would not be labelled as a functional test for muscle. The reason being that agility requires several skills simultaneously. As we saw in the previous section, to be agile you must have good balance and coordination, as well as reaction speed, and muscular power. Interestingly, power can be in a positive or negative fashion. The ability to brake (stop motion or momentum) quickly is a key to agility. As mentioned, the ability to accelerate is a function of power, thus someone with high power is often quite agile.

There are many types of agility tests and many of them are designed for a particular sport. The property of being agile is to be able to start, stop, and change direction quickly. Thus, most field and court sports will require this. Some sports require more side-to-side movement such as soccer, volleyball, and tennis, and some require more back and forth- football and baseball but most sports require all of these. Three different agility tests will be presented here. Students can try on or all three. Each varies slightly from the others.

There are a few items needed for this. First a nice flat, high friction surface that is relatively large. Second is a tape measure or phone with measuring capacity. Third is some chalk or cones, and lastly a stopwatch or phone with this capacity. The first one (**Three Cone Test**) is used in the NFL combine and it has replaced the 4 cone or box drill.

Three marker cones are placed to form an "L." with cones at the corner and at each end, 5 yards (457 cm- 4.57 m) apart.



- The subject starts by getting down in a three-point stance just left of Cone 1. If you are timing yourself, have your finger ready on the start button and be in a semi-squat.
- Run to Cone 2, bend down and touch a line or base of the cone with your right hand.
- Run back to Cone 1, bends down and touches a line or the base of the cone with your right hand.
- Run back to Cone 2 and around the outside of it, then inside Cone 3, then around the outside of Cones 3 and 2 before finishing at Cone 1 and hitting "stop" as you pass the cone 1 as fast as possible.
- The player must run forward while altering his running direction, as opposed to strictly stopping and starting in opposite directions.

- Perform the 3-cone drill on both sides (e.g. first left, second time then right). You only need to switch cone 3.

The time to finish (TTF) in seconds is recorded. The score is the best TTF of two trials.

The second test- The Agility T-test- varies from the first in that the subject is facing forward the entire time as their body moves in all four directions. This test demonstrates someone's shuffling and running backwards skills. Shuffling is moving the body sideways without crossing the feet. The backwards run is often called back pedaling because of how it mimics the pedaling motion when done correctly.

The setup is similar to the L test but this time you will form a T with the middle line being 10 yards (9.14m) and the two lateral cones 5 yards or 4.57 meters from the center cone.

The subject starts at cone A. On the "go" command, or hit the start button as you leave (self administered). the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touches its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. They then shuffle back to cone B touching with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A.

The trial will not be counted if the subject crosses one foot in front of the other while shuffling, fails to touch the base of the cones, or fails to face forward throughout the test. Take the best time of three successful trials to the nearest 0.1 seconds. The table below shows some scores for adult team sport athletes.

	Males (seconds)	Females (seconds)
Excellent	< 9.5	< 10.5

Good	9.5 to 10.5	10.5 to 11.5
Average	10.5 to 11.5	11.5 to 12.5
Poor	> 11.5	> 12.5

Ensure that the subjects face forwards when shuffling and do not cross the feet over one another. For safety, a spotter should be positioned a few meters behind cone A to catch players in case they fall while running backward through the finish.

The last (3rd) test-The 20 yard shuttle agility test- also called the Pro Shuttle test or more accurately the 5-10-5 Shuttle. It is the simplest and shortest agility test and it is also used in the NFL combines. Three cones are set up in a line, with cone A in the middle and cone B 5 yards to the subjects right, and cone C 5 yards from cone A on the subjects left. Upon starting the subject is straddling cone A just in front of it, he runs to cone B and the foot needs to touch a line even with the cone, turn around and run 10 yards to the C cone, with his foot again touching the line even with the cone and run back to the A cone and past it. This is testing a person's ability to stop, start and accelerate, not move side to side or backwards. Timing stops as the athlete passes cone A.

Thought Questions

1. What sports can you think of (not mentioned) where agility is quite important to the performance? What type of agility (side to side or back and forth or both) is important?
2. What components of fitness go into agility?
3. Do you think agility is hard on the joints? Could it be source of injury in sport?
4. What drill have you done or can you think of that would improve agility?

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CHAPTER OVERVIEW

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8.1: Part A- Heart Rate Lab

Part A- Heart Rate Lab

Heart Rates- Resting, Exercise, Max predicted, and Max Aerobic

The heart is always considered a “central factor”! Let get to the “heart of the matter”, what is the “heart of this subject”. If you love someone, they have your heart! It is of central importance because nothing happens without it! It has one primary function- pumping blood. It has some other functions including lowering blood pressure- via atrial natriuretic peptide, and of course it is under autonomic nervous system control. Thus, strongly connected to our emotions and thus why love is associated with it. It even helps with lymphatic transport and thus fluid balance or regulation.

<https://www.acefitness.org/education-and-resources/professional/expert-articles/3502/advances-in-aerobic-training-how-to-apply-the-new-heart-rate-formulas> (Links to an external site.)

As you have probably learned, the heart rate is very reliable in predicting the intensity of a given exercise. As energy output increases, the demand for oxygen increases, and need to remove carbon dioxide, and hydrogen (via acid) increases the chemoreceptors feedback to control the heart rate and stroke volume. The stroke volume will increase just like the heart rate but only up to a certain point, and then the heart rate only will increase until it reaches its maximum.

We will examine the bottom (resting heart rate) and top (predicted maximum heart rate) of the heart rate range and the percent differences between these two. This difference is known as- heart rate reserve- and it is likely the most neglected physiological variable in the common public. This method is often called the *Karvonen method*, for the researcher who popularized it. The only person with a heart rate of zero is...dead! Then why is it used? It should not be and this is why we will show how incorrect it can be for predictions. Fun fact, the heart rate reserve (HRR) and aerobic capacity (VO₂) reserve have a very high correlation, but percent of maximum heart rate (the old system) is not well correlated to VO₂ reserve.

 Jupiter Health Metabolism During Exercise » Jupiter Health

In addition, many endurance athletes have resting heart rates in the 40s, while average people are about 70 bpm. Thus, the difference between minimum and maximum (reserve) is much larger for the athlete and this needs to be considered with the calculations. Differences between the 50% HRR and 50% of max heart rate using the maximum method (220-age or Tanaka et al.) can be about 35 beats/min!

Heart Rate Calculations Worksheet

1) **Get your true resting HR (RHR).** This should be after you have been still for 5 min, and best if it is after waking up. A minimum of 15 second duration- 4* HR= RHR in beats/min (bpm)-30 or 60 second is better.

2) **Calculate your predicted maximum heart rate (MHR) use the standard formula ((220- age) and Tanaka et al 208- (age * 0.7).** Show me the difference- it should only be a few beats for most. *Hint- it is 3 beats/min lower for every decade you are below 40, and 3 beats/min higher for every decade above 40.*

3) See the table below. You need to put units in your cells and explain your work (math).

a) Calculate your Heart Rate Reserve (**HRR**) or Kavornen rate (MHR-RHR) for 50, 60, 70, 80, and 90% using Tanaka Max HR. So once you get the difference between max and resting (reserve) you multiply it by .5 or .6 for 50% and 60% respectively, all the up to 100% (which should be the same). You must add back your resting heart rate to the %HRR number you got!

b) compare this to your Tanaka Max * % for each of the 6 %s. Example given for 50% in table below.

· So for a 24 yo- (208- (24*.7))= 208- 16.8= **191.2**. Round down to 191 to get the Max HR (MHR)

· Now multiply 191 by * 0.5 = 95.5 bpm round up to **96**. This is the 50% max HR.

· To calculate 50% HRR- If RHR is 71- then we subtract max from resting- 191-71= 120 is the HRR.

· The HRR is now multiplied by 50%= 120 * 0.5= 60. We now must add back the RHR 71 to get = 131 vs 96- this is a 35-bpm difference! Huge!! **Do this comparison for all the 6 different %s.** Hint- the difference is smaller as you go up.

c) Give me a table with the two different ones in columns and heart % in rows and the final column is the difference between the two. Graph it if you want. It is easy and cool to see.

% HR MAX (intensity)	$[(\text{Tanaka max} - \text{RHR}) * \%] + \text{RHR}$	$(\text{Tanaka max}) * \%$	Difference of Two
50	131	96	35
60			
70			
80			
90			
100			

4) Calculate your "maximum aerobic function" (MAF) HR which is $180 - \text{age}$ and -5 for poor condition, $+5$ bpm good condition, 0 for average condition. Look up MAF HR for more info- <https://philmaffettone.com/180-formula/>

5) Pick an easy and hard activity and tell me your heart rate and the HRR% you obtained.

a. Get your heart for the high intensity activity- say 170

b. Subtract your resting HR- say 70 à $170 - 70 = 100$

c. Take your HR reserve, if you are 24 yo à Tanaka max would be 191 so HRR= 121

d. Divide your Exercise HR/ HRR à $100/121 = 82.6\%$ - this is your high intensity HRR

Another way to look at it: $(\text{Exercise HR} - \text{RHR}) / (\text{Max HR} - \text{RHR})$

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8.1.1: Heart Rate Calculations Worksheet



Working on it. Stay tuned

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SECTION OVERVIEW

8.2: Part B- Aerobic Capacity Estimation

Part B- Aerobic Capacity Estimation

One of the most sought-after measurements for endurance athletes is their ability to use oxygen to produce energy (ATP). This is known as maximal oxygen consumption (VO₂max) and it can be directly measured with sophisticated equipment or predicted, as we are doing here. In some sports like road cycling or running, it is very predictive of the champions or not. In other sports like off-road (mountain) cycling or swimming, it is not as predictive because the skill level becomes a strong determinant.

There are many tests that have been developed to gauge the aerobic condition of someone. Some give a specific number in terms of the VO₂max, and others give just a ranking word- like very good or fair.

VO₂ Max Chart for Women by Age (ml/kg/min)

Classification	18-25	26-35	36-45	46-55	56-65	66+
Excellent	>56	>52	>45	>40	>37	>32
Good	47-56	45-52	38-45	34-40	32-37	28-32
Above average	42-46	39-44	34-37	31-33	28-31	25-27
Average	38-41	35-38	31-33	28-30	25-27	22-24
Below average	33-37	31-34	27-30	25-27	22-24	19-21
Poor	28-32	26-30	22-26	20-24	18-21	17-18
Very poor	<28	<26	<22	<20	<18	<17

VO₂ Max Chart for Men by Age(ml/kg/min)

Classification	18-25	26-35	36-45	46-55	56-65	66+
Excellent	>60	>56	>51	>45	>41	>37
Good	52-60	49-56	43-51	39-45	36-41	33-37
Above average	47-51	43-48	39-42	36-38	32-35	29-32
Average	42-46	40-42	35-38	32-35	30-31	26-28
Below average	37-41	35-39	31-34	29-31	26-29	22-25
Poor	30-36	30-34	26-30	25-28	22-25	20-21
Very poor	<30	<30	<26	<25	<22	<20

Because the size of the person matters in how much oxygen they can take in, transport, and utilize, the measurement is based on the kilogram weight of the individual. So, the milliliters of oxygen per kilogram of body weight per minute or ml/kg/min is the unit of VO₂.

All the tests are based on giving the individual a certain amount of work then measuring their heart rate or in some cases blood gases during ventilation (which requires a fancy and expensive machine). Heart rate alone is fine for most estimations. The first part of this section will use the Rockport Walk Test to estimate a maximum. It will also use a formula to calculate the actual VO₂ of the walk itself. Thus, someone can find out what percentage of maximum they were on the walk. The limitations of the Rockport Walk test will be explained. It is a great test because the slower someone walks the lower their heart rate will be. Thus, it is calculating the relationship between these two. Unfortunately, it is not accurate for runners or people of better aerobic condition.

It is important the subject stays at the same pace throughout the mile. He should walk at a challenging pace but not too fast, and definitely should not go faster at the end. Get the heart rate within 5 seconds of finishing as instructed above. Carotid pulse is the easiest to get. Practice doing it first.

8.2.1: Rockport Walk Test Calculation

[8.2.1.1: Worksheet for Rockport Walk Test](#)

8.2.2: 12-minute Run Test-

8.2.3: 1.5 mile Run Test

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SECTION OVERVIEW

8.2.1: Rockport Walk Test Calculation

Part B1- Rockport Walk Test Calculation

$$132.853 - (0.0769 \times \text{Weight}) - (0.3877 \times \text{Age}) + (6.315 \times \text{Gender}) - (3.2649 \times \text{Time}) - (0.1565 \times \text{HR})$$

Where:

- Weight is in pounds (lbs)
- Gender Male = 1 and Female = 0
- Finish time is in minutes and 100ths of minutes. Every 6 seconds is a 0.1, every 15 is 0.25 minutes
- Heart rate is in beats/minute. Make sure to take the HR for 10 seconds and multiply by 6 to get beats/min. If you had 20 beats in 10 seconds, it would be $20 \times 6 = 120$ bpm
- Age is in years

We will now figure out what % of your VO₂max you did the walk in. Using the example previously, the VO₂ was 14.23 for a person who walked a mile in **15 minutes**. If that person was a **30 year old male**, weighing **160 pounds**, and had a **110 bpm heart rate** for the walk- then estimated VO₂max from the Rockport is:

- $132.853 - (0.0769 \times 160) - (0.3877 \times 30) + (6.315 \times 1) - (3.2649 \times 15.0) - (0.1565 \times 110)$
- $132.853 - 12.304 - 11.631 + 6.315 - 48.974 - 17.215 =$
- $139.168 - 90.124 = 49.0$ ml/kg/min

So- $14.23 / 49 = 29\%$ of the VO₂max. Which is about right for a moderate intensity walk. The percentage of heart rate reserve was 34%. These two values are relatively close to each other. If we used % of Max HR it would be $110/187$ or 59% nowhere near the other values.

Calculation of VO₂ from Walking Speed (on the Rockport test)

$$\text{VO}_2 = [0.1 (\text{ml/kg/min}) * \text{walking speed (meters/min)}] + 3.5 (\text{ml/kg/min})$$

- 1) Find out your finishing time. 1609.3 meters/mile so if you did the mile in 15 minutes
- 2) $1609.3/15 = 107.3$ meters/min
- 3) So $.1 * 107.3 = 10.73 + 3.5 = 14.23$ ml/kg/min is the metabolic cost to walk that speed (no incline).
- 4) The grade (% incline) was eliminated from this equation because we were on a flat surface. You would add the term $[1.8 \times \text{speed (m/min)} \times \text{grade (\%)}]$.

8.2.1.1: Worksheet for Rockport Walk Test

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8.2.1.1: Worksheet for Rockport Walk Test



Working on it. Stay tuned

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8.2.2: 12-minute Run Test-

Part B2- Other Aerobic Capacity Test (for Runners)

Calculation of VO₂ from Running Speed and Grade

$$\text{VO}_2 \text{ (ml/kg/min)} = (0.2 \times \text{Speed (m/min)}) + (.9 \times \text{Speed} \times \text{Grade}) + 3.5$$

1. If you are monitoring your running in miles per hour you will need to multiply by 26.82 to convert it to meters per min.
2. If you are on a flat surface then then you can eliminate the blue colored term.
3. You will need to convert seconds to minutes by simple dividing it by 60.

12-minute Run Test-

A simple and easy way to estimate someone's VO₂max is with the 12-minute Run Test, developed by the Cooper Institute. This test is best for runners and those who have good motivation. It is best done on a track for easy determination of the distance and level ground. A standard track is 400 meters, not 440 yards, as the old tracks were in the U.S.A. The subject should be well rested have proper running footwear and clothes and make a maximum effort. Make sure to measure to an 1/8th mile or 50 meters.

$$\text{VO}_{2\text{max}} = (35.971 \times \text{distance (mi)}) - 11.288, \text{ or } (22.351 \times \text{distance (km)}) - 11.288$$

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8.2.3: 1.5 mile Run Test

1.5 mile Run Test

Same conditions as the 12-minute run test but this is a set distance and time is the variable. This may be done on a treadmill, but it was not designed to be. Make sure seconds are converted to 100th minutes.

$$\text{VO2max} = 483 / \text{time (min)} + 3.5$$

If the subject was able to complete the 1.5 miles in 11 minutes and 40 seconds, we would need to convert seconds into minutes so $40/60 = 0.66$ minutes so, plugging this in

$$\text{VO2 max estimate- } 483/11.66 = 41.42 + 3.5 = \underline{44.92 \text{ ml/kg/min}}$$

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8.3: Worksheet for Rockport Walk Test and HR/VO2 comparison

Worksheet for Rockport Walk Test- Heart Rate and Aerobic Capacity Comparisons

For any given exercise, unless it at maximum, you are operating at some percentage of maximum and this is how exercise physiologists gauge intensity- % maxHR or % VO2max. We will be figuring out both in this section. First- calculate all things in parenthesis like- age, weight, time and heart rate- then take 139.168 subtract age factor, weight factor, time factor and HR factor- males add- 6.318 or start with 145.486

To get your HR max and Heart Rate Reserve

- Say you had 110 heart rate at the end of the walk and you are 30 years old.
- $208 - (30 \times 0.7) = 208 - 21 = 187$ estimated max.
- If your resting heart is 70, we now subtract maximum from resting to get 100% HRR
- So HRR is- $187 - 70 = 117$ bpm

We will be making the following 3 comparisons in this lab after you have found out: 1) the heart rate you finished at, 2) your predicted maximum (Tanaka et al), 3) your VO2 for the walk, and 4) your predicted maximum VO2- Rockport formula number.

I. First we will compare the heart rate %max to VO2%max

- Figure out the % of maximum heart rate you did the walk in- Divide 1 by 2
- Figure out the % of maximum VO2 you did the walk in- Divide 3 by 4
- Compare A (above) to B (above)

II. Now we are going to compare heart rate reserve (HRR)% to VO2 max %.

- Use $(\text{Ex HR} - \text{RHR}) / (\text{Max HR} - \text{RHR})$ to get HRR%
- Use the same number in I-B- for the %VO2max
- Come up with the %s and compare them- closer or farther than I?

To get your %HRR for the walk or any exercise- $(\text{ExHR} - \text{RHR}) / \text{HRR}$

- You then need to subtract the resting from your exercise heart rate (ExHR)
- $(\text{ExHR}) 110 - (\text{RHR}) 70 = 40$, then divide 40 by the HRR or 117= $40/117 = 34\%$

III. Now we are going to compare the HRR% to the VO2 reserve.

- Baseline is 3.5 so $\text{Max} - 3.5 = \text{VO2 reserve}$
- Compare this to what you got in II. Is it closer or farther than the other two?

In Summary-

- Use the Tanaka formula to get your heart rate max (HRmax).
- Take your (exercise HR minus resting) and divide that by(HRmax- resting) to get %HRR
- Calculate your walking VO2
- Calculate your estimate VO2max from the Rockport Mile Walk Test formula
- Divide C by D to get %of VO2max
- Take your Walk VO2 and subtract 3.5 then divide Rockport VO2 and -3.5 to get VO2 reserve %
- Compare the HRR% to the VO2 reserve %

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8.3.1: New Page

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8.3.3: New Page



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8.3.4: New Page



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CHAPTER OVERVIEW

9: Flexibility- Range of Motion

[9.1: Part A- \(Apley\) Back Scratch Test](#)

[9.2: Part B- Sit and Reach](#)

[9.3: Part C- Torso Twist](#)

The term flexibility is an interesting one. The dictionary definition is “the capability to bend easily without breaking”. Socially speaking, a flexible person will be open to suggestions or not have a strong opinion and is easy to get along with. In exercise physiology, it describes the range of motion someone has in a given joint. Being flexible is important for many sports such as gymnastics, diving, or even wrestling. Someone should be flexible enough in a joint to maintain proper biomechanics during a movement. Being flexible may be a disadvantage if it compromises the strength or power of an athlete.

There are three main areas where flexibility is commonly measured- upper body chain, torso, and lower body chain. The shoulder, chest, and elbow areas which represent the upper body chain. The lower back, hips, back of knee (hamstrings) which represent the lower chain, and the thoracic movement in the transverse plane is sometimes measured as well, and this is representative of core flexibility.

This manual will use the back scratch, the sit and reach (seated or sitting on the ground), and the torso turn tests to measure flexibility in those key areas just mentioned, respectively.

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9.1: Part A- (Apley) Back Scratch Test

Part A- (Apley) Back Scratch Test

The Back Scratch test will measure two different things in each arm, so it is important to do the test with both arms in the different positions. The first arm goes behind the head and the person is trying to touch the superior portion of the opposite side scapula. This measures the abduction and external rotation of that arm. The other hand reaches low and attempts to touch the inferior aspect of the opposite side scapula. This measures the adduction, and internal rotation of that arm. You would then measure the distance between the middle fingers. If there is overlap, you measure this as a positive value and if the hands don't touch that distance is a negative value. Note the scales presented are for elderly individuals and the range is from above average to below average.

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9.2: Part B- Sit and Reach

Part B- Sit and Reach

The Seated sit and reach test will measure the vertebral, hip and hamstring flexibility. The person should be seated in a standard folding chair. The gluteal fold should be on the edge of the chair and the foot should be dorsiflexed 90 degrees with the heel on the ground. The person should have the middle fingers overlapped and they reach forward as far as possible. Like the scratch test, if the person can stretch all the way to where the tip of the shoe is touched by the tip of the middle finger then it is a zero. If they reach past the toes it is positive and not reaching the toe is negative.

The sitting sit and reach will require some tape, like masking tape and a yardstick. The person should be warmed up with a couple toe touches and a loose back. The shoes need to be off and heels will line up with the edge of the tape. The legs should be flat on the ground with no knee bend and the feet can be 10-14 inches apart, depending on their height. The person should breathe out and slowly extend forward with the head down, and the hands overlapped. The edge of the tape should be on the 15-inch mark on the yard stick to recreate the standardized sit and reach box.

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9.3: Part C- Torso Twist

Part C- Torso Twist

The final test is a quick reference to any back injuries or limitations. The subject stands with the feet about shoulder width, knees slightly bent, and the fists of the person should touch at the height of the mid- sternum. The elbow should be at the height of the fists. The person should to the side rotating as far as they can while keep the fists together and in front of the sternum. You should see about 45-degree rotation with the hips and 90 with the upper torso.

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CHAPTER OVERVIEW

10: Immunology

10.1: Part A- Preventing COVID19 and Its Spread

10.2: Part B-Psychoneuroimmunology (Stress and Immune System) -Discussion

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10.1: Part A- Preventing COVID19 and Its Spread

Part A- Preventing COVID19 and Its Spread

The pandemic of the century. This is what the Corona Virus was and many of us- firsthand- the impact it had on society. Most of us also know how airborne virus can be spread and the basic PPE to be used in defense of the virus infecting us. The SARS CoV-2 is COVID19, which stands for Corona Virus started in 2019 (in China). Viruses are 100-1000 times smaller than eukaryotic cells. The virus must hijack the nucleus of a cell to make copies of itself. Also, viruses are tricky in their capacity to mutate quickly, thus all the new variants arose after much of the population had “herd immunity” or vaccinations.

Read this article:

<https://www.nytimes.com/2020/03/13/health/soap-coronavirus-handwashing-germs.html> (Links to an external site.)

Watch this cute short video that is very informative (TED Ed) video on the Corona Virus

<https://youtu.be/D9fTi-CDjDU> or the one below

<https://ed.ted.com/lessons/what-is-a-coronavirus-elizabeth-cox>

Watch this dramatic time line on Coronavirus. The red is deaths, and the U.S. is late but comes on strong- real strong later in it!

<https://youtu.be/X31Z2ycbatk> (Links to an external site.) 

This is a really actual time on coronavirus pandemic numbers. <https://www.youtube.com/watch?v=NMre6IAAAiU%C2%A0%28Links+to+an+external+site.%29&feature=youtu.be>

Excellent NY Times article on the Pfizer vaccine and how it works with our immune system to do the job. <https://www.nytimes.com/interactive/2020/health/pfizer-biontech-covid-19-vaccine.html>

Optional video (meant for kids)- cute and short but nothing that great-<https://youtu.be/GoXxmzKdick> (Links to an external site.)

Answer these 4 Questions- some with multiple parts. Answer the main question but other questions may help contribute to your answers.

- 1) Did you learn anything about COVID19 recently or from these videos? Name 3-4 things
- 2) What was your family doing to protect against getting it? Do you wear masks, isolate, wash hands, use sanitizer etc. Family gatherings? Hang with friends?
- 3) Did you think it was going to go on so long? Did you experience COVID fatigue? Burnout. In March 2020 would you have guessed this result?
- 4) Did our leadership do a good job or not on controlling the spread? Are we doing better now? The USA seems to be far worse than other countries.
- 5) What is your opinion on the use of the vaccine? Did the priority system work?

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10.2: Part B-Psychoneuroimmunology (Stress and Immune System) -Discussion

Part B-Psychoneuroimmunology (Stress & Immune System) -Discussion

Your brain's connection to the immune system (and vice versa)

Many people speak of the brain and body connection. Well it is not more evident than when witnessing the effects of stress on our immune system. Psychoneuroimmunology (PNI) is the science behind the brain and immune system talking to each other and how you can think yourself sick or well (which sounds like fake science but its very real). So you should tell me with a paragraph or more for each:

1. What is PNI and how does it work? I want to see how the effects of mental stress can influence the immune system and potentially how the neuroendocrine system (stress hormones) play a role in this interaction. **Watch this Crash Course video**

<https://youtu.be/4KbSRXP0wik> (Links to an external site.)

2. Give some example of PNI in action in the literature. State the scientific facts

[What is healing? | Shamini Jain | TEDxOrangeCoast](#) (Links to an external site.)

<https://youtu.be/Kk7kzUt3-Lc>

(Good talk but mostly on the mind's ability to heal, not PNI directly)

[Psychoneuroimmunology | How Stress and Depression Make You Sick](#) (Links to an external site.)

<https://youtu.be/gfXk7WWNDjQ>

The guy talks a little monotone but hits the main highlight of PNI

3. Bring it to Life! State some time or situation in your life where you were either quite stressed and possibly low sleep and how you felt bad or were ill soon after.

o My example- after I had to move all my stuff from Hurricane Katrina under very hard and miserable conditions including no electricity and mold and some other issues- I got sick on the way home and really sick once unloading my stuff.

Provide the references- at end of discussion, TED talks are fine, or websites you got it from.

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CHAPTER OVERVIEW

11: Respiratory

[11.1: Part A- The Talk Test](#)

[11.2: Part B- Breath Hold](#)

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11.1: Part A- The Talk Test

Part A- The Talk Test

There are some really fancy ways to determine someone's anaerobic or lactate threshold. We will go into the details of this in class but not in this assignment. When you start really pushing your breathing your talk becomes interrupted. This phenomenon is being used by the **Talk Test**. You should recite something you know really well. Happy birthday, pledge of allegiance, the ABCs. Don't sing because it takes more O₂- just talk at a normal volume. The whole point of the Talk Test- is to determine your 3 different exercise zones:

- **Zone 1- is below VT1- All Aerobic- you can speak in full sentences easily**
- **Zone 2- is between VT1 and VT2- Aerobic and Anaerobic mix- some difficulty speaking in full sentences, but still able to speak without great difficulty.**
- **Zone 3- is above VT2- All Anaerobic-you can only get out a few words at a time.**

I WANT TO MAKE IT CLEAR- BECAUSE A LOT OF PEOPLE MESS THIS UP!!! YOU ARE ONLY GOING TO DETERMINE YOUR VENTILATORY THRESHOLD 1 AND 2!! You will also do a "warm up" (below VT1)

Watch the video <https://youtu.be/e8vRWNb0suE> and then- Find out your two thresholds by exercising at increasing intensities and find out your heart rate (%HRR) and RPE when:

- 1) You are having difficulty speaking in full sentences. **This is your ventilatory threshold- VT1** and the cutoff between Zone 1 and beginning of Zone 2. It means you are no longer totally aerobic.
- 2) You go from some difficulty saying a sentence to **a lot of difficulty saying words. This is your VT2 and it represents you going anaerobic.** This is the cut off from the end of Zone 2 and 3.

I want four things at each cut-off (VT1 and 2). These go into the rows. The columns are the zones

1. **The heart rate** you are at for each- VT1 and VT2 but I also want one for like a warm-up where you are clearly able to speak in full sentences.
2. **The HRR% of your heart rate.** Review- other section (Ex HR- RHR)/ (MaxHR- RHR)
3. The **rating of perceived exertion**. Sort of like the pain scale in a hospital. Give your exertion scale when you hit those VT1&2 values. Look it up (I WANT A 10 PT SCALE- NOT 20 PT- Borg scale).
4. **A description of how the talking was. Just a sentence or two- not a word or two!**

Perform some exercise at three different intensities: (warm-up, VT1, VT2) and make sure to come down slowly from VT2. This should feel very hard. Like 80% on HRR% and an 8 on a 10 pt exertion scale.

Make a table with: a) your intensity (if the machine measures something or a run speed or what you were doing- jogging, running, sprinting) great if not just say what you did. b) Your HR, c) HRR%, d) RPE for each zone/cutoff and e) how you were able to talk or not - so a 5 rows and 3 columns would be good. **Comment on anything you learned or thought was interesting.**

Level	Activity/ Level	HR(bpm)	%HRR	RPE(1-10)	Description of Talking
Warm Up	Walk				
VT1	Jog				
VT2	Sprint				

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11.2: Part B- Breath Hold

Part B- Breath Hold

Before and After Hyperventilation

It is important to do this exercise before reading on so as to not influence the results.

Procedures

- A. Get a partner (or not). If you have a partner, then one is the *subject* and one is the *observer*. The observer, will need to set their phone to “stop watch mode” or have a watch with a stop watch feature. Worst case simple record the time elapsed in seconds.
- B. Have the subject student sit upright and quietly (no talking or moving) in a chair.
- C. The subject should be inhaling normally, then if solo, hit the stopwatch as you stop breathing (hold your breath). If a partner is present- tell the subject to stop breathing with a “go” and hit the watch or phone.
- D. The subject should hold his or her breath as long as he/she possibly can. Tell the subject to force himself or herself to continue holding his/her breath even if he feels like he has to breathe.
- E. Observer: record how long his/her subjects held their breaths.
- F. Ask the subject to take a short rest about 1 minute. Then to breathe rapidly and deeply for 30 seconds (called hyperventilation). Immediately after hyperventilating and toward the end of an expiration (outward breath), have each subject hold his/her breath, and signal the observing student as before.
- G. To make timing easier, start a watch and simply subtract 30 seconds from it at the end or whenever the subject finished hyperventilation and started the breath hold. Again, instruct the subject to hold his/her breath as long as possible
- H. Observer: record how long the subject held his/her breath.

Analysis

1. Compare your breath-holding times with and without prior hyperventilation. Check to see if there is any difference. Do absolute before – after and % change (After- Before)/ Before
2. Why was there a difference?
3. At the point you thought you really had to breathe, could you talk yourself out of it, even if only for a few seconds?
4. What finally forced you to breathe?
5. What limits how long you can hold your breath?
6. What factors, other than high carbon dioxide, might cause breathlessness?

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CHAPTER OVERVIEW

12: Digestive

[12.1: Part A- The Gut Brain Microbiome Axis- Discussion](#)

[12.2: Part B- Are you What you Eat?](#)

[12.3: Part C - Corn Test](#)

This page titled [12: Digestive](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Mark Kelly](#).

12.1: Part A- The Gut Brain Microbiome Axis- Discussion

Part A- The Gut Brain Microbiome Axis- Discussion

The gut microbiome does a whole lot more than you ever thought. Or perhaps the guts are making you not think about them! Just kidding. Seriously it is highly fascinating to think that the gut microbiome that has been around for billions of years and out numbers our own cells at a 10:1 ratio, may actually be a "centerpiece" of our health and functioning including our psychological functions. Watch these videos (first 2 quite popular). The second one has a couple million views! The fourth one explains things quite simply including the thing I could not think of (Kimchi). Anyway, watch these before **commenting on them and the subject in general**- then let it rip! **I want to hear how this assignment may influence your diet or lifestyle too.**

https://youtu.be/FWT_BLVOASI (Links to an external site.) 

<https://youtu.be/awtmTJW9ic8> (Links to an external site.) 

<https://youtu.be/oym87kVhqm4> (Links to an external site.) 

not a TED talk but a very short (2 min) video from Duke explaining the basis and the enterendocrine cells role.

Optional one but pretty good-<https://youtu.be/B9RruLkAUm8> (Links to an external site.)

Guiding Questions or Points that should be addressed:

- 1. Is the gut microbiome actually significant enough to influence our health and thinking?**
- 2. Do you think we can learn more about the gut microbiome and improve people's health or even cure diseases?**
- 3. Do you do anything, or would you like to do anything to help your own gut microbiome?**
- 4. After you take antibiotics, have you ever felt bad or try to re-establish your microbiome?**

Have a good discussion.

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12.2: Part B- Are you What you Eat?

Part B- Are you What you Eat?

The Role of Nutrients in Health, Microbiome, Quality of Life

Watch the four videos. I have each one aimed at a question, but they are there to encourage thought and your own perspective. There is a lot of systems that get affected by diet. I am a board member of the Medical Fitness Education Foundation and I have educational products I hope to launch in this area that include how to fight chronic diseases with exercise and nutrition.

I personally am a strong believer in the various effects of nutrition on our short term and long term health. However, I am not as strict or restrictive as many in my field are. I am not that concerned with each and everything I put in my body and I do many things that are likely not good for my health, such as alcohol consumption, and I like my desserts every so often . I do use supplements, but not as regularly as I should, and I believe they only do "some" good and are definitely not a cure or even as effective as getting nutrients through food. They are likely a good insurance policy to certain deficiencies, but others in my industry swear by supplements and spend a lot of money on them. Answer the following 3 question areas on your personal diet and supplement regime and belief on gut microbiome. or even your gene expression?

What is NUTRIGENOMICS? What does NUTRIGENOMICS mean? NUTRIGENOMICS ([external site](#)

What is NUTRIGENOMICS? What does NUTRIGENOMICS mean? NUTRIGENOMICS meaning, definition & explanation.)

1) Do you believe that what you eat has effects on your health (Short or Long -term or Both)? If so, in what ways? Do you make efforts toward your health goals with food?

<https://youtu.be/ouAccsTzIGU> (Links to an external site.) 

2) Do you supplement with nutritional items, or just try to get it in food, or don't care? If so, do you try for a certain quality of supplement?

<https://youtu.be/5ODkZQ9JOaQ> (Links to an external site.) 

3) Do you think what you eat affects your gut microbiome, which affects your overall health? More on this topic later.

<https://youtu.be/1sISguPDlhY> (Links to an external site.) 

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12.3: Part C - Corn Test

Part C - Corn Test

Finding Out the Scoop on your Poop

So this is an interesting lab and won't call it "hands on" because it involves other body parts besides your hands- LOL. The ability to determine your "transit time" in your gut is not easy. One of the simple ways is to eat something that does not digest and you can see. This is where corn comes into play. While the inner portion of the corn kernel can be digested the out portion is cellulose and this can't be digested.

In general, the transit time from ingesting corn to the small intestine is quite short. The majority of the time for the transit time is spent in the large intestine. While there is a lot of variability between individuals, it would normally be about 24 hrs. with about 12 hrs. of variability. Thus, if someone's transit time is less than 12 hours, it is usually diarrhea, and if it is more than 36 hrs, it is commonly constipation.

Part 1

<https://www.eric.org.uk/blog/how-fast-are-your-bowels-take-the-sweetcorn-test-to-find-out> 🌽 (Links to an external site.)

Part 2

<https://www.webmd.com/digestive-disorders/poop-chart-bristol-stool-scale#:~:text=The%20shape%20and%20form%20of,and%207%20tend%20toward%20diarrhea.>

These articles go into it in a lot of detail. I just want the following things:

1. **Time you ate the corn and approximately the amount (weight or servings- wt better)**
2. **Time it took to leave your system- beginning and end (not usually all gone in one movement)**
3. **Classify the movement according to the system mentioned- #s assigned to textures (See part 2).**
4. **Compare your time to the recommendations or suggestions in the article. Do you agree with it? Are you slow/fast/normal usually.**
5. **Corn can change the transit time in some. Did it for you?**
6. **Did you find "getting the scoop on your poop" interesting? Have you ever thought about your digestive health before?**

After you look at the website- Please mention the Type of feces you had (closest guess).

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CHAPTER OVERVIEW

13: Urinary

13.1: Part A- The Vitamin O.D

13.2: Part B- Asparagus Test

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13.1: Part A- The Vitamin O.D

Part A: The Vitamin O.D.

So you will need to take **double or triple the dose of multi-vitamin** you would normally take or is suggested. It should include a wide series of the B-vitamins. Don't worry a single day of this will not have any ill-effects on you. For the asparagus record about how much and when you ate it.

- 1) Record the approximate “transit time” (consumption to traces in urine).
 - 2) Look at the urine color and compare it to your normal color- and try to have similar hydration states.
 - 3) Be aware of the smell- is there any odor to it- again compared to normal- especially with the asparagus test.
 - 4) What type of vitamins (water or lipid soluble) do you suspect are in it? For asparagus test do research on the compound that is released in some.
 - 5) Look up what (vitamins/minerals/elements) can affect urine color or odor?
 - 6) Did you notice extra bubbles (foam) in the urine?
-

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13.2: Part B- Asparagus Test

Part B: Asparagus Test-

answer same questions



Working on it. Stay tuned

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CHAPTER OVERVIEW

14: Genetics

[14.1: Part A- Phenotypic Analysis- 23 and You](#)

[14.2: Part B- Who Are You? Nature or Nurture-Biopsychosocial Theory](#)

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14.1: Part A- Phenotypic Analysis- 23 and You

Part A- Phenotypic Analysis- 23 and You

So I will want you to make an in-depth analysis of your physical and behavioral characteristics. I want two tables with at least 6 variables each. You should have at least one sibling (if there is one) listed and your mother and father. You may use a spouse and children if this applies.

Characteristics as rows, people as columns- or lose points.

1) Physical Characteristics: You can use anything from obvious ones like height, weight, or frame type, to less obvious like ear lobes, to chins, to eye color mono or bi eyelids (for Asians), or even hair texture, thickness, color, head shape, skin color or oily or dry etc. (minimum of 6- more like 10 is better here). Feel free to give ethnic background and if you are "typical" or different for this group.

2) Behavioral characteristics;: You need to do another table using behaviors or psychological traits, abilities etc. Music or math ability, outgoing/extrovert, likes movies or type of movies, addictive qualities, athletic, scientific or quantitative, artistic or creative, cooking, clothes preferred, spending habits, shopping enjoyment or not, etc. Again minimum of 6. *It is a time to rip on your bro or sis- just kidding.* I **strongly prefer tables with headers in bold and characteristics actually described better than one word.** Sometimes is okay like brown or green eyes or straight or wavy hair.

3) At the end I want a summary of what you learned or thought of it. Like- I had 5 characteristic like my dad and 3 like my mom, but behaviorally I had 6 with mom and 4 with dad. I tend to be more like my dad physically but my mom behaviorally. A couple of paragraphs- separate the physical and behavioral analysis in each paragraph.

Example Table: Physical Trait Comparisons

Trait	Father	Mother	Me	Sister
Eye color				
Hair color				
Hair texture/thickness				
Ear lobes				
Height				
Frame				
Skin texture- oily/dry				

Example Table: Physical Trait Comparisons

Behavioral Trait	Father	Mother	Me	Sister
Extro/intro-vert				
Likes shopping				
Spends/saves money				
Addictive qualities				
Movies they like				
Artistic or scientific				
Easy going vs particular				
Athletic-Competitive or not				

2 Paragraphs on analysis of each table- here.

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14.2: Part B- Who Are You? Nature or Nurture-Biopsychosocial Theory

Part B- Who Are You? Nature or Nurture-Biopsychosocial Theory

The age-old argument or discussion on nature or nurture is the topic here. This is basically an extension of the 23 and You project. You were born with certain genes that gave you certain physical characteristics. You were also born into a certain family and community that trained your behaviors, and the activities you perform, what you where, what languages or accents you speak with, and of course what you eat. Answer the following questions in this discussion:

- 1. How much do you think your genetics/phenotype have influenced the way you are?**
- 2. How much do you think your parents, family, community, or even state/country have influenced the way you are?**
- 3. How much do you think YOU have decided what you will be like- now and in the future?**

Do you know of skills or knowledge that comes easily for you? Do your parents do those things too? Do you know of things you are "terrible" at or hate doing? Fit them in if it helps your discussion.

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