Name _____ **Instructor** _____ **Lab Section**_____

Objectives: To gain a better understanding of:

- The process of digestion and assimilation of food
- The sources and functions of various types of food
- The biology of human nutrition

Background material may be found in

- Chapter: 21.2, 21.4 – 21.21

Biology: Concepts and Connections, 8th ed.

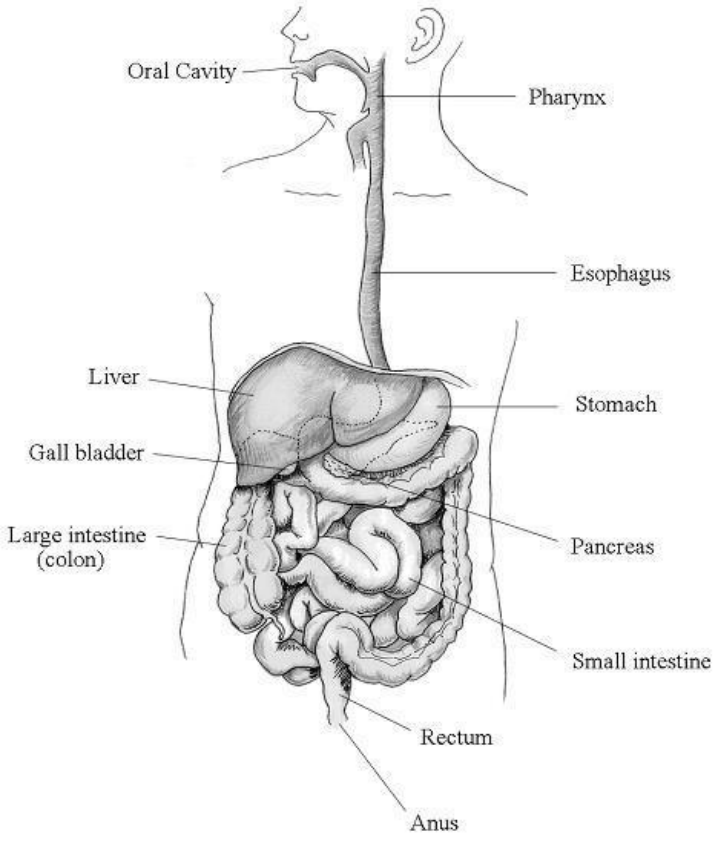
The topic of food and its effect on our lives has been the recent focus of much attention. We are constantly being exposed to the "whats, hows, and whys" of good nutrition from a variety of information sources.

That food is important to our personal lives is obvious to us all. In terms of our health, an improper diet can lead to malnutrition, obesity, or disease. Likewise, life span, physical fitness, risks for certain diseases and mental development are also influenced by an individual's diet. Food also has additional dimensions in that "food habits" (eating patterns and rituals) are an integral part of our cultural, social and psychological make-up.

Unfortunately, much of what is said about food and nutrition is clouded by belief or emotion, and is based on scant or misinterpreted information. In addition, the results of nutritional science studies (like all randomized scientific studies) are based on averages; however, we are each 'biochemical individuals', and each respond slightly differently to varying nutrients. It is, therefore, often difficult to judge and assess the "facts" when dealing with nutrition. The purpose of this exercise is to give you a background in the biology of human nutrition with which you will be better able to make decisions concerning personal dietary matters.

By "nutrition" we are referring to the processes by which the body takes in and uses substances that we call "food" for growth, maintenance, and development. The lab will include a consideration of (1) digestion, (2) the body's use of food, (3) the sources and functions of various types of foods, and (4) a discussion of some facts and fallacies surrounding nutrition.

Organs of the digestive system and related structures



Pre-Work Required for the Nutrition Lab

To begin this assignment, you must generate a complete list of every food item you ate in one 24-hour period. You must also produce a complete list of every physical activity you performed in the same 24-hour period (every minute of the 24 hours must be accounted for). These data will be entered into the CRON-O-Meter software, which is found at www.cronometer.com. The online program will then provide you with nutritional information that will be used to complete the lab. In order to obtain accurate data, do your best to observe the *amount* you eat (ounces, cups, tablespoons, grams, etc), and *time* (in minutes) spent in various physical activities. Write it all down on the following two pages. The more observant you are, the better the data and results will be.

Foods Consumed in 24 Hours

Breakfast Foods	**Amount**

Lunch Foods	**Amount**

Dinner Foods	**Amount**

Snack Foods (throughout the day)	**Amount**

Pre-Work Required for the Nutrition Lab

Physical Activities in 24 Hours

Your basal metabolic rate (see page 14.7-8) will be calculated (from your age, height, weight, and gender) and accounted for in the computer program. However, **you will need to account for all of your activity and exercise throughout the day/night – for a total of 24 hours (1440 minutes).** In addition to sports or fitness activities, be sure to include time spent sleeping, eating, sitting, standing, exercising, showering, dressing, writing, reading, shopping, cleaning, cooking, sitting on the couch, and all other activities. Depending on the entry, you may find it useful to differentiate the degree of difficulty for each activity -- light, moderate, heavy, fast, slow, rigorous, etc.

These activities will be entered into the computer to determine the number of calories you burn in a "typical" day.

Activity	**Degree of Difficulty**	**Time Spent**

CRON-O-Meter Instructions

Use any computer with internet access to complete this assignment. When finished entering the 24-hour consumption and activity data, it will be analyzed online. The information produced will be used on the following pages to complete your lab assignment.

Create Profile

Go to the website www.cronometer.com

- Click on **Sign Up Now** (green box).
- Complete Step 1: "Create a New Account". Enter your email address (a valid one – you will need to retrieve a message sent to you in order to begin) and create and repeat a password. Then click "Create Account".
- Check your email for a message from CRON-O-Meter, and enter (copy/paste) the Validation Code sent to you in the pop-up box.
- In order to get estimated calories expended, **you must enter your gender, birthdate, height and weight**. Then click "Set Targets".
- Basic instructions follow; once you've read them, click "Start Using CRON-O-Meter".
  - If you wish to adjust your email preferences to avoid receiving unwanted emails, you can do so by choosing **"Profile"**.

Food Intake Data Entry

- Scroll to the top of the page. Along the top (orange) menu, click **"Diary"**. You will remain on this page for the rest of the lab.
- Click on **"Add Food"** (apple image).
- **Enter Food Item** into the search box. You'll see a list of possible items; choose the one that best matches your food/beverage.
  a. For example: enter BAGEL.
  b. Click on the item that *best fits* what you ate (perhaps it's "bagel: whole wheat, plain or seasoned")
  c. Adjust the serving and/or size, and then click **"Add Serving".**
- Repeat the steps until you have entered all the foods and beverages you consumed in your 24 hour period. *Don't forget to add all water and beverages you drank.* (Hint: If you enter a food that item that is not found in the search, try entering a similar food that is more common. For example, instead of "Tri-tip", you might search for "Steak.")
- When you have finished entering all your foods and beverages, it's time to enter your physical activity.

Physical Activity Data Entry

- Near the top of the page, click on **"Add Exercise"** (image of person running).
- Enter activity into search box. As with food, possible matches will appear in a list; choose one that best matches your activity.
  a. For example: enter COOKING.
  b. Click on the item that best fits what you did and the level of effort.

  You may need to play with a few keywords to find a fitting activity. A search of "weights" may come up empty, but if you type "lift weights," you will see "Resistance training" appear as an option.

  c. Adjust the time spent on this activity at the bottom of the box, and then click **"Add Exercise".**
- Repeat steps a through c until all activities performed in 24 hours are entered.

You have completed the data entry portion of this lab. You will need to refer to the computer screen periodically as you complete the second section of this lab (Part 2: How the Body Uses Food and Part 3: Essential Nutrients and Basic Nutrition). If your time on the computer is limited, you may wish to temporarily skip (and go back to later) the first part of the lab (Part 1: Digestion). The computer software will save your data (under the date you entered it), so you may complete this lab over several sittings if need be (just remember your login and password!).

I. DIGESTION AND A REVIEW OF THE DIGESTIVE SYSTEM

In order for food to be used by the body it must first undergo a number of physical and chemical changes. The term "digestion" refers to those processes occurring in the digestive system that convert food into a form that can be absorbed, distributed and used by all cells of the body. This is achieved by:

Mechanical Digestion - where food is physically broken down and moved through the digestive system, and;

Chemical (enzymatic) Digestion - where food is chemically broken down (primarily by enzymes).

Structures and Functions of the Human Digestive System

Brain – various parts of the brain interact to interpret signals such as the smell, sight, or thoughts of food and then act to begin the process of digestion by triggering salivation in the mouth and excretion of gastric juices in the stomach. This process can only effectively begin when the parasympathetic nervous system is activated, i.e. a person is relaxed. *If you are under stress while eating, you are not likely to digest your food well.* Later, the brain also receives and interprets signals from the stomach and intestines related to fullness, and acts to decrease hunger sensations[1].

Oral Cavity – the mouth

Teeth – bones that mechanically break up food. Note in humans, evolved to be omnivores (eating plant and animal matter), the dentition is differentiated into three tooth types, each with a specialized function.

Incisors - sharp, knife-like teeth, for snipping and cutting off bits of food.
Canines - pointed, conical teeth, used for seizing and tearing food (your "vampire" teeth).
Pre-Molars & Molars - flattened, large teeth with cusps (ridges) for grinding and crushing food.

Tongue - serves the dual purpose of tasting and manipulating the food into a mass called a **bolus** in preparation for swallowing.

Saliva - serves to moisten, soften and lubricate food to facilitate its passage to the next part of the digestive tract. Saliva contains amylase, the digestive enzyme that begins the breakdown of carbohydrates in the food. Not all mammals have salivary amylase (it is missing in both cattle and horses).
In humans, the enzymatic breakdown of carbohydrates begins in the mouth.

Note: the **uvula** which "hangs down" at the back of the throat is not the epiglottis, but rather a tissue structure which normally helps prevent food from entering the nasal passages during swallowing (the uvula is bypassed when "milk comes out your nose").

Pharynx - the passage in the back of the oral cavity through which both food and air can pass. A flap of skin called the **epiglottis** covers the opening of the windpipe (**trachea**) to prevent its obstruction by food.

Esophagus - the long muscular tube running down the throat and chest to the stomach. When stretched by the bulk of the food within, circular **smooth muscles** lining the esophagus contract in waves (**peristalsis**) to squeeze the bolus of food down to the stomach.

Stomach - a large muscular sac, lined with mucous and whose walls contain digestive glands. In the presence of food, the glands release gastric juices that contain **hydrochloric acid (HCl)** and **digestive enzymes that can break down proteins**. The stomach undergoes muscular contractions (peristalsis) which churn the food, mixing it with gastric juice and mechanically breaking it into smaller pieces to increase its surface area for further enzymatic digestion. **In humans, the enzymatic break down of proteins begins in the stomach**.

Small Intestines - the soupy mixture of gastric juice and food, termed **chyme**, then passes to the long tubular small intestine, where most digestion and absorption occurs. As the chyme is passed into the small intestine by peristalsis, **bile** from the **liver** (used to break down fats and stored until needed in the **gallbladder)** and digestive juices from the **pancreas** (containing digestive enzymes and bicarbonate ions) are added. The bicarbonate ions released from the small intestine help neutralize stomach acid so that the pancreatic digestive enzymes can effectively breakdown the

carbohydrates, fats and proteins present in the chyme**. In humans, the enzymatic break down of fat begins in the small intestine.** Associated with the walls of the small intestines are capillaries of the vascular system and lacteals (lymphatic capillaries) of the lymphatic system that absorb the nutrients and transport them to the rest of the body.

Large Intestines (colon) - the remaining undigested material is then passed from the small to the large intestine, where large numbers and many species of beneficial bacteria (a.k.a. 'gut symbionts') feed on the food mixture and create/donate vitamins such as B1, B2, B12, and K to the body. Additionally, it is here that water and salts are absorbed before the remaining material is passed on to the rectum. The **appendix** is attached to the first portion of the colon. Though for many years the appendix was thought to have no significant function in adults, recent evidence suggests it may play a key role in repopulating the large intestine with beneficial gut symbionts following an episode of dysentery or a round of antibiotics.

Rectum - this last segment of the intestines is a storage chamber for unusable food waste, some water, bacteria, and sloughed off epithelial cells of the digestive tract, collectively termed **feces**. At **defecation**, the **anal sphincters** relax and the feces exit the body through the **anus**. It is interesting to note that the color of the feces is primarily due to the waste product of the breakdown of hemoglobin from dead RBCs (bilirubin) and that a pronounced and sustained change in the color of a person's feces (to either black or pale/white) is worth mentioning to a doctor as it may indicate either bleeding in the digestive tract or a blocked bile duct. **Half of the dry weight of the feces consists of dead bacteria.**

Questions

1. What type of digestion occurs in the oral cavity? (circle one)
   a. Mechanical digestion only
   b. Chemical (enzymatic) digestion only
   c. Both mechanical and chemical digestion

2. Teeth can tell us a lot about how and what an organism eats. Humans have three kinds of teeth. This suggests that humans evolved to eat
   a. Animals only
   b. Plants only
   c. Both animals and plants

3. What type of enzyme is found in saliva, **and** what is its function?

4. What is the function of the epiglottis?

5. In humans, the chemical digestion of carbohydrates begins in the _____, the chemical digestion of protein begins in the _____, and the chemical digestion of fat begins in the_____.

6. A diverse community of bacterial gut symbionts is crucial in humans for effective digestion, strong immune function, and to provide several important vitamins. However, bacteria are short-lived and must be replaced often (you can facilitate this process by eating cultured or fermented foods such as yogurt or sauerkraut). **What fraction of the dry weight of feces is made up of dead bacteria?**

II. HOW THE BODY USES FOOD

Metabolism

After digestion and absorption, nutrients are used by the body to carry out various life processes. The overall chemical changes that these nutrients undergo are referred to as metabolism.

Metabolism involves two processes:

1. The breakdown (**catabolism**) of nutrient substances, primarily with oxygen (aerobic respiration) for the release of energy (production of ATP) to do work (e.g. heat production, movement, etc.)

2. The build-up (**anabolism**) of complex molecules from simpler nutrient subunits for growth, repair, and maintenance of body structure. Anabolism requires/uses ATPs.

The Need for Energy

Energy contained in food is expressed in terms of a measurement known as the calorie, abbreviated as lower case c. **A calorie is defined as the amount of energy required to raise the temperature of 1 gram of water one degree Celsius.** Typically food energy is measured in units of **kilocalories, written as Calories with a capital C, or abbreviated as Cal simply or capital C.** A kilocalorie is the equivalent of 1000 calories. This energy unit is a measure of the heat energy produced by food when the food molecules are broken down by aerobic respiration. **Note that the "calories" shown on a nutrition label are actually kilocalories.**

Energy demands of the body are of two basic types:

A. Basal Metabolic Rate (BMR) – the minimal caloric requirement needed to sustain life. This is the amount of energy your body would expend if you slept all day (24 hours). Basal metabolic rates vary among individuals according to a number of factors including age, sex, level of physical fitness, overall health, etc. The Basal Metabolic Rate for an average person of your gender, height, weight, and age can be calculated with the following formula:

Women: BMR = 655 + (4.35 x weight in pounds) + (4.7 x height in inches) - (4.7 x age in years)
Men: BMR = 66 + (6.23 x weight in pounds) + (12.7 x height in inches) - (6.8 x age in years)

B. Voluntary Work - the use of energy for voluntary activities such as walking, swimming, reading, etc.

The total energy required by an individual therefore includes energy used by both the voluntary and involuntary work performed by the body.

Questions

1. Define the term "calorie".

2. Define Basal Metabolic Rate (BMR).

3. Calculate "your" BMR using the formula above (noting that your particular BMR may vary from this average for a number of reasons).

   Your BMR (based on formula): _____

4. a. What does the computer program Cronometer.com calculate your BMR to be? (*Look in the "Calories Summary" box below your list of foods/activities. Mouse-over the purple bar labeled "Basal Metabolic Rate".)*

   Your BMR (based on program): _____

   b. Why are this number and your answer to #3 different (in other words, what factors not accounted for in the formula influence one's Basal Metabolic Rate)?

Comparison of Calories Consumed to Calories Expended in Your 24 Hour Diet

You monitored your diet and physical activity for a 24-hour period. During that time, you consumed a certain number of calories in your food and expended a certain number of calories through exercise. Ideally, these 2 values, "Calories in" and "Calories out", are matched. If you exercise more on a given day of the week, you get hungrier and eat more. If you exercise less on some other day, you are less hungry and eat less. Homeostatic mechanisms that control hunger and satiety act to match the input and output of Calories so that your body can maintain constant energy. The simple theory goes that over-eating or under-eating disrupts this balance, resulting in weight gain or loss.

These homeostatic mechanisms depend on you listening to and acting on your body's signals; there are many more reasons to eat than simple hunger (i.e. habit, social gatherings, comfort, stress, etc.). **Keep in mind, also, that weight gain and loss varies with many more factors than simple "Calories-in-Calories-out", including the quality of food choices, timing of meals, proportions of different macronutrients (carbohydrates vs. proteins vs. fats), blood sugar balance, hormonal balance, mineral or vitamin deficiencies, and accumulation of metabolic toxins.** When one or more of these factors are at play, an overweight person may significantly reduce caloric intake, yet still not be able to lose weight.

1. How many Calories were in the food you consumed in the 24-hour diet? *(Look in the "Calories Summary" box below your list of foods/activities. This number is in the left-hand circle with the apple image.)*

   Calories consumed _____

2. How many Calories did you expend (due to basal metabolic rate plus physical activity) during the same 24-hour period? *(This number is in the right-hand circle with the fire image.)*

   Total Calories Expended _____

Questions

1. Compare the Calories you expended with the Calories you consumed *(the screen gives a visual representation of this with two overlapping bars).* Assume the 24-hour diet and physical activity logs accurately reflect your typical day. Did you get enough Calories to meet your needs? Did you ingest a lot more Calories than you expended?

2. List 3 physiological factors that may complicate the simple theory of "Calories-in-Calories-out".

   1.

   2.

   3.

3. Despite the complications above, working to equate Calories ingested with Calories expended is a good start if you have a goal of body weight maintenance. Do you think you need to make any changes in your diet or activity level? **Be specific, how?**

III. ESSENTIAL NUTRIENTS & BASIC NUTRITION

In order to adequately nourish the body, one must eat foods containing various types of chemical substances called nutrients.

To be classified as a nutrient, a chemical must:
1. Supply the body with heat and energy, and/or,
2. Be used to build and repair body tissues, and/or,
3. Regulate one or more of various bodily processes necessary for survival (homeostasis).

The six groups of essential nutrients are:
- ***Water***
- ***Proteins***
- ***Lipids (fats and oils) + Cholesterol***
- ***Carbohydrates***
- ***Vitamins***
- ***Minerals***

For optimal health, these nutrients should come from **nutrient-dense, whole, unprocessed, fresh foods. Nutrients consumed in capsule or tablet form do not provide other nutrients, beneficial compounds, and fiber that often accompany nutrients obtained through fruits, vegetables, and other whole foods.** Unfortunately, in modern American culture, much of what passes as food (e.g. doughnuts, frozen pizza, sugar-free popsicles, prepackaged children's lunch trays, "fruit" yogurt, soft-batch cookies, fish sticks, microwave popcorn, etc.) is not whole and unprocessed, and hence does not promote optimal health (and in many cases impairs physiological function).

How Effective Is Your Diet at Maintaining Optimal Health?

Use the information from the computer analysis of your diet to answer the questions below.

A. Water in Your Diet

Water is the most important nutrient in the body; it is required by every cell and tissue. Because it cannot be stored over the long-term, it must be constantly ingested. Water should be consumed throughout the day. Interestingly, our diet choices can affect our hydration: Many fresh foods, such as fruits and vegetables, contain large amounts of water (think of a watermelon!), whereas many packaged foods are dry in comparison.

Seek to drink the appropriate amount of high-quality (filtered, if possible) water every day. You can calculate the approximate amount needed each day with the following equation (though amounts vary depending on the individual with factors such as exercise and air temperature):

Body weight (lbs) / 2 = minimum # ounces water needed per day (tip: 8 ounces = 1 cup)

Diuretic beverages can deplete the body of water stores by encouraging loss of water through urination (due to osmosis). Diuretics include coffee, caffeinated tea, soda, "energy drinks", some fruit juices, and alcohol. You may need to drink more water (to replace that which is lost) when you drink diuretics. **If you are drinking enough water, your urine should be colorless or light yellow.**

1. Given your approximate body weight, and using the formula above, calculate the expected minimum number of cups of water you should drink per day. (tip: 8 ounces = 1 cup)

_____

B. Protein in Your Diet

There are approximately 23,000 different proteins in the human body. Proteins play extremely diverse and important roles in the body, including structure, transport, communication, movement and catalysis. A healthy body is possible only if protein synthesis is fully functional.

Proteins are long polymers of amino acids. There are 20 different amino acids. The body can synthesize 12 amino acids from simpler compounds, but the remaining 8 must be consumed in the diet. These are the so-called 8 **Essential Amino Acids. Complete proteins** are foods that provide all 8 essential amino acids. Meat, poultry and fish are complete proteins and thus are an excellent source of protein. **Vegetarians** (especially vegans) must be vigilant to get enough protein; foods must be combined properly in order to obtain all essential amino acids. "Complementary Proteins" are combinations of plant foods that provide complete proteins. **Soy foods** can be a useful source of protein, but overconsumption of soy and soy protein can disregulate sex hormone balance or thyroid hormone production, as well as block your body's uptake of crucial minerals. These adverse effects can be avoided by consuming fermented soy foods (such as miso, tempeh, or natto), or limiting intake of processed soy products.

To ensure that you obtain enough amino acids, it is recommended that protein comprise ~25-35% of one's daily calories. **Consequences of long-term protein deficiency** can include loss of muscle mass, increased infections and illness, skin rashes, emotional effects such as edginess and irritability. Examples of good protein sources include beef, pork, chicken, turkey, fish, whole milk dairy products, eggs, legumes (beans and peas), quinoa, nuts and seeds.

Questions

1. What makes an essential amino acid different from other non-essential amino acids?

2. What is a complete protein?

3. Can a vegetarian diet provide complete proteins? ***How?***

Refer to the computer screen. Scroll down to the "Nutrient Targets" box (just below "Calories Summary" box). Based on your age, sex, height, weight, and activity level, the computer provided a "target" diet (series of stacked bars: yellow, green, blue, and red). **Look at the green bar**.

4. How many grams of protein are in your "Target" diet (*number on right side of slash*)?

5. How many grams of protein did you actually consume in your 24-hour diet (*number on left side of slash)*? What percentage of your target protein did you ingest (*in parentheses*)?

6. Based on this comparison, do you get enough protein in your diet?

7. What are the consequences of consuming too little protein for extended periods of time?

C. Lipids (Fats and Oils) in Your Diet

When fats and oils are ingested in foods, they are broken down into molecules called fatty acids and glycerol. Fatty acids play many crucial roles in the body. Just a few of these roles include phospholipids (the primary components of cell membranes), hormones (signaling molecules – critical for nearly every body process), and carriers for fat-soluble vitamins (see "Vitamins" section D of lab). Perhaps most importantly, **fatty acids are an important source of energy for the body**. We metabolize fats and oils (lipids) to obtain energy (ATP) for cellular work. Lipids contain more energy per gram than other food sources. There are 4.1 Calories/gram in carbohydrates and proteins, and 9 Calories/gram in lipids. Given the fact that lipids have more energy per gram than either protein or carbohydrates, it's not surprising that humans have evolved to use fat as our main energy storage molecule.

Many of us have been told to completely avoid fats, especially **saturated fats** (those found primarily in meats, dairy, eggs and butter). While diseases such as atherosclerosis (hardened/clogged arteries), heart disease, and high cholesterol, as well as obesity, have been blamed for decades on diets high in saturated fat, recent scientific analyses reveal that these health effects are most likely linked to Trans fats, which are fats that are chemically altered to improve shelf life, mouth feel, etc. **Trans fats are commonly found in fried foods, packaged baked goods, fast food, etc., and were clumped with saturated fats in early studies of the associations between fat intake and health.** In fact, **saturated fats are a very important part of a healthy diet as they can increase bone health, lower the risk of heart disease, protect the liver from alcohol and pharmaceuticals, and enhance immune function, and constitute over 50% of the fatty acids in cellular membranes.**

For optimal health, we should not only eat foods rich in saturated fatty acids (meats, eggs, dairy, shellfish, coconut oil), but we should balance them with mono-unsaturated (olive oil, nuts, avocados) and the **Essential "Omega 3" poly-unsaturated fatty acids (coldwater fish such as salmon and trout, flax seed, hemp seed).** Essential Fatty Acids, like Essential Amino Acids, cannot be made by the body and must be eaten.

A healthy diet (according to traditional diets worldwide[4]) contains ~25-35% of daily calories as *quality* lipids.

Eat	Avoid
~30% Saturated fats from pasture-raised animals &/or coconut oil	Trans-fats (processed foods)
~60% Monounsaturated fats (olive oil, avocados)	
~10% Essential Polyunsaturated fats (fish, flax, hemp)	

Questions

*Refer to the computer analysis of your 24-hour diet to answer these questions. Fats are denoted in **red** on your screen.*

1. What percentage of your daily Calories come from (total) fat *(red bar, in parentheses)?* _____

2. *Scroll down from the red bar and look for the box entitled "Lipids".* Did you meet your goal for Omega 3 fatty acids? For saturated fatty acids? If you were deficient in either one, what foods might you add to your diet to make up for the insufficiency?

3. Why is fat an important part of a healthy diet?

4. Did you ingest any trans-fats? Given what you read above, what food(s) did you eat that you suspect might have had trans-fats in them? *(To check this, select the suspected food in your list on the computer program by clicking once on it, and then scroll down to see the breakdown of fats for that particular food.)*

5. What are some health consequences of eating trans-fats?

Cholesterol in Your Diet

Cholesterol is an essential component of cell membranes and is also the precursor to sex hormones and those that regulate blood sugar and stress responses. Cholesterol is also one of the body's most effective repair substances, especially with tears and irritations in the arteries. Cholesterol is vital to brain and nervous system function and is used to make bile, which is needed for the digestion of dietary fats. The human body manufactures cholesterol, but must have the correct building blocks to do so (Acetyl-CoA, usually obtained from dietary fatty acids). Foods with a healthy fat profile, which generally include dietary cholesterol (see "Lipids" section above), must be eaten so your body can make the cholesterol it needs.

Good sources of Cholesterol Precursors
Meats, with fat
Organ meats (ideally grass-fed)
Dairy products (from grass-fed cows)
Eggs (ideally from pastured hens)
Wild-caught seafood

Questions

1. Was your cholesterol intake at or near zero *(found at bottom of "lipids" breakdown)*? If so, do you think this is an adequate intake for your body's needs?

2. What foods do you eat that are good sources of cholesterol?

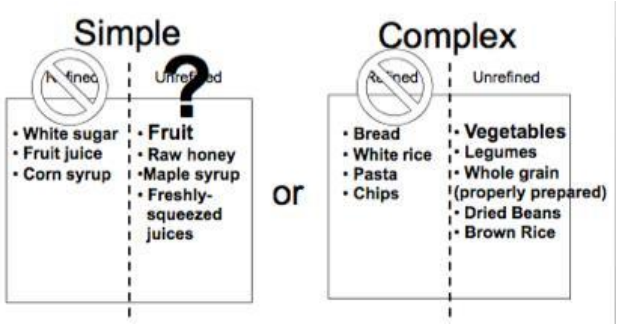
3. List 2 important reasons why your body needs cholesterol.

D. Carbohydrates in your Diet

Carbohydrates are sugars such as **glucose** and polymers of sugars such as **starch** and **cellulose**. The major role for carbohydrates in the body is as a fuel supply. Although many of the body's systems prefer to use fats for energy (see "Lipids" section above), **the brain's only source of energy is glucose.** Carbohydrates are "burned' through cellular respiration to provide ATP energy for cellular work. Cellulose is an indigestible polymer of glucose from plant cell walls that provides "fiber" for the diet. **Indigestible fiber creates bulk in the intestines and hence increases the efficiency of digestion by stimulating peristalsis.** Starch is an energy-storage molecule of plants, found in grains and root vegetables. **Vegetables, legumes, fruits and whole grains are an excellent source of complex carbohydrates because they provide vitamins, minerals, fiber and starch.** Quality carbohydrates should compose 35% – 45% of calories in a healthy diet.

By contrast, simple carbohydrates (sugars) are considered "empty calories" because they lack fiber and other nutrients. The average American consumes 22 teaspoons of added sugar per day (over 85 lbs per year). A can of regular soda contains ~35 grams (8.75 teaspoons) of sugar. The American Heart Association recommends the following maximum levels of sugar intake: 24 grams (6 tsp) per day for females and 36 grams (9 tsp) per day for males.

In the 1970s and 80s, the American public began to be admonished for including fats in their diets (see "Lipids" section above). As people learned to fear fats, many turned to refined carbohydrates, including products made with nutrient-devoid refined (white) flours and sugars (to increase flavor and volume in their diets). Eating high levels of sugar on a daily basis puts the sugar-handling organs of the endocrine system (liver, pancreas, and adrenal glands) under undue stress, often leading to insulin-resistance and diabetes. If Americans as a whole continue to eat as they do now, the Centers for Disease Control and Prevention estimates that 1/3 of all Americans will be diagnosed with diabetes in their lifetime.



Questions

1. What percent of your total calories in your 24-hour diet were carbohydrates *(blue bar in "Nutrient Targets" box)*? How does this compare to the target of 35-45%?

2. Give an example from your diet of a(n)
    a. Refined simple or complex carbohydrate

    b. Unrefined simple or complex carbohydrate

3. Biologically-speaking, what is cellulose/fiber, and what is the advantage of it in your diet?

4. What percentage of your target for fiber did you ingest *("Carbohydrates" box on screen, below stacked bars)*?

5. How many grams of sugar did you consume during your 24-hour diet *(same location as above)*? How does this compare to the maximum amount recommended by the American Heart Association?

E. Vitamins in Your Diet

Vitamins are simple organic molecules that most often function as coenzymes (enzyme helpers). Vitamins help to catalyze metabolic reactions in the cell, but are not consumed by those reactions. Like enzymes, they are recycled time and time again. **Vitamins are essential to maintaining health (for our *vitality* -- note the same root as "vitamin"), yet are required in only small amounts.**

A healthy diet contains 13 essential vitamins. Nine of these are water-soluble vitamins such as vitamin C and the B vitamins. The other 4 are the fat-soluble vitamins A, E, D, and K, which can only be acquired by eating fats (both plant- and animal-based). Though needed in only small amounts, vitamins are absolutely required; vitamin deficiencies result in serious physiological conditions. For example, **vitamin B_{12} deficiency can result in weakness and fatigue, pale skin, rapid heartbeat and breathing, and/or digestive disorders**, and a deficiency in vitamin K could lead to uncontrolled bleeding (internal or external) or calicification of soft tissues and arteries. (**B_{12} is found primarily in meat, dairy and eggs, and vegans need careful supplementation. Sugar and/or alcohol addictions often lead to B_{12} deficiency as they strip B vitamins from the body.** Vitamin K can be found in dairy, eggs, liver, leafy green vegetables, kelp, and molasses.) However, excessive consumption of vitamins can also be dangerous. Water soluble vitamins are readily excreted by the kidney and therefore do not accumulate in the body. On the other hand, when fat soluble vitamins are consumed in large quantities (as with excessive supplementation) they accumulate in fat cells and may reach toxic levels. Take heart, though, that it is virtually impossible to overdose on any vitamin by consuming whole foods alone.

Water Soluble Vitamins	Fat Soluble Vitamins
Vitamin B1 (thiamine)	Vitamin A
Vitamin B2 (riboflavin)	Vitamin K
Vitamin B6	Vitamin E
Vitamin B12	Vitamin D
Pantothenic acid	
Folic Acid	
Biotin	
Niacin	
Vitamin C	

Questions

1. *(Refer to the box entitled "Vitamins", below stacked bars on your computer screen.)* Compare the amount of Vitamin B_{12} you consumed in 24 hours to the recommended amount for a person of your age, sex and size. Assuming this is your typical daily diet, do you get enough vitamin B_{12}?

2. What are some medical conditions associated with vitamin B_{12} deficiency?

3. If you are deficient in vitamin B_{12}, what foods can increase your intake of this important nutrient?

4. Why are vitamins required in such small doses compared with other essential nutrients such as essential amino acids?

5. Can a person overdose on vitamins? ***If so, which ones and why***?

F. Minerals in Your Diet

Minerals are inorganic elements. About 25 essential minerals are required to maintain a healthy body. Our bodies cannot make minerals; we must eat them in our food. Like vitamins, minerals are essential, yet required in small amounts. Examples of essential minerals include, iron, calcium, phosphorus, sulfur, sodium and magnesium. Minerals play a multitude of roles in the human body. For example, **calcium is used to harden bones, and is also required for proper function of all our muscles, including the cardiac muscle in the heart.** Mineral deficiencies may lead to disease. For example, **calcium deficiency** may lead to bone-related diseases such as osteoporosis (low bone density), and extreme calcium deficiency may result in arrhythmias of the heart.

Questions

1. *(Refer to the box entitled "Minerals", below stacked bars on your computer screen.)* Compare the amount of calcium you consumed in 24 hours to the recommended amount for a person of your age, sex and size. Assuming this is your typical daily diet, **do you get enough calcium**?

2. What is one function of calcium in the body?

3. What are the consequences of calcium deficiency?

G. Food Additives – Processed Food – Junk Food

Intentional Additives
Such additives include preservatives, enzyme inhibitors, flavor enhancers, anti-oxidants, emulsifiers, stabilizers, thickeners, separating agents, leavening agents, drying agents, coloring agents, bleaching agents, and non-nutritive sweeteners. They are designed to keep our food free from bacteria and mold, and to make it more palatable by preserving its flavor or color, and to maintain its texture. Other additives such as Vitamin A and D, thiamine, riboflavin, niacin, and iodine may be introduced to attempt to fortify the nutritional value of our processed food.

Incidental Additives
These additives include such contaminants as radioactive fallout, pesticides, chemical fertilizers, animal antibiotics, and other contaminants that are introduced into our food primarily during the growing stage. Though approved for use in our foods by the USDA, many of these chemicals have not been conclusively proven safe for long-term human consumption (and in fact, some are known carcinogens).

Additives (both intentional and incidental) can be best avoided by eating fresh, whole foods, grown/raised without pesticides, growth hormones, or antibiotics of any sort, and with minimal or no processing.

Questions

1. What is an example of an intentional additive that might be harmful to some people?

2. Give an example of an incidental additive that might be harmful.

3. Give 2 examples of foods you could add to your diet that are likely to be free of food additives.