Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2012 Volume III: Anatomy, Health, and Disease: From the Skeletal System to Cardiovascular Fitness

Understanding the Effects of Diet and Fitness on the Human Body through Mathematical Equations and Statistical Analysis on Calorie Intake and Calories Expended

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Rationale

Think for a second about the number of questions you have about your body! Our ancient ancestors knew far less than we do about the human body. Questioning and research over hundreds of thousands of years has increased our knowledge of energy, waste, nutrition, and exercise. Scientists of the human body make a living studying and testing theories to help us maximize our potential. But who has access to this clandestine information? This unit addresses the problem of obesity and lack of knowledge about diet and nutritional health in many urban communities. Teachers and students will analyze the effects of diet, exercise and genetics on the human body. The lessons and activities in the unit are designed to better inform students about their bodies. Students will begin to pay closer attention to the amount of food they eat. They will also develop eating habits that are relative to rest, physical activity, and particular times of the day. Discussions will begin on the skeletal system and move towards muscle formation and cardiovascular function. Bone development and the impact of aerobics at an early age will be an important lesson that may have a real tangible impact on many students who are concerned with or want to maximize their own physical form. In addition, students will be able to contrast the effects of protein and fat intake on lean muscle formation. Carbohydrates will present a fun new concept for students to grasp.

There will be a unique opportunity for students to familiarize themselves with Microsoft Excel and PowerPoint. Each student will practice designing surveys, creating data logs, and presenting the results of their data.

At the conclusion of the unit, students will understand the important role the thyroid gland plays in hormone production and metabolic rate. Students will have a comprehensive and insightful understanding of why being too thin is just as dangerous as being too fat. They will walk away with an awareness of how water and other essential nutrients regulate the human body. Students will better understand what their body needs to perform at its peek physical and mental capacity. Enrichment exercises for advanced students will include creating algebraic equations to express net intake (food consumption – energy burned).

Lack of Physical Activity in the School Day

It is widely known that the public school curriculum does not adequately address the physical needs of the current generation of elementary and middle school children. In the late 1950's, President Dwight D. Eisenhower created the President's Council on Youth Fitness. Over the past four years, Mayor Michael R. Bloomberg of New York and Michelle Obama have teamed up to bring childhood obesity back to the forefront [1]. A dramatic rise in obesity statistics created a perfect opportunity for them to convince policy makers that obesity was prevalent and creating serious health risks for the low-income and minority populations. In New York City alone, the number of students receiving no physical education classes in an average week rose 6.1 percent in 10 years [2]. In 2012 alone, more than one-fifth of high school students in New York were not even given an opportunity to work off some of the empty calories and fat they consumed during breakfast and lunch [3]. Many more probably choose to sit out of gym and not maximize this time for needed cardiovascular and muscular fitness.

Other states and school districts are in need of desperate improvement as well. In San Francisco, only one-fifth of elementary school students exercised for twenty minutes per day; thus meeting the state requirements [4]. Legislatures in the Miami-Dade School District threatened to cut all physical education classes for sixth, seventh, and eighth graders in the 2011-2012 school year. While administrative educators and policy-makers blame falling property values and budget cuts for the cuts in physical education, our children face serious and life-threatening diseases and health risks.

The combination of large class sizes and a lack of urgency among teachers and students create major time constraints. There is not enough time for teachers to inform students about proper diet and fitness. Students come to school and substitute gum, candy, potato chips and soda for the school breakfast. And the alternative is not a healthy morning meal in the first place. Title I ensures that students in low-income neighborhoods receive free or reduced breakfast and lunch; however, most students pick at the meat, toss the vegetables, and consume other foods that are high in sugar or saturated fats. This unit will allow students to learn first hand the effects of every food they put in their bodies. Students also spend most of the school day sitting down. Many go home to watch television or play video games. Even though metabolic rates are high for elementary and middle school children, poor nutrition and lack of routine or daily exercise has caused childhood obesity to more than triple in the past 30 years [5]. In 1980, the percentage of children aged 6-11 years old in the United States who were obese was 7%. A similar study in 2008 showed that nearly 20% of children aged 6-11 years old were overweight. The Center for Disease Control and Prevention defines obese or overweight as having excess body weight or fat. The comparison is based on a child's height and weight. Children and teenagers under the age of 17 have a 70% chance of developing a risk factor for cardiovascular disease [6]. The biggest goal of this unit is to teach children about the potential health risks of an improper diet and provide them with the tools and motivation to develop a fitness routine that fits their personality and lifestyle.

The self-directed projects in the unit will allow students to calculate their daily calorie intake. Based on this measure, students can calculate how many minutes of exercise is needed to prevent unhealthy weight gain.

Teaching Strategies: Introduction to New Material

Power Point Presentations

PowerPoint presentations are a fun interactive way for students to engage in new material, concepts, vocabulary, and note taking. Allow students who have earned special recognition for their effort and engagement to take turns acting as the clicker.

Newspaper & Journal Articles

Published articles allow students to read and analyze different opinions on key issues in fitness and nutrition. Students should keep a journal reflecting on each newspaper, magazine or website article they read.

Short Films & Documentaries

Short films and video clips will expose students to nutrition and fitness as a real world phenomenon. Experimental studies will entertain students while teaching them about the urgency of changing their eating and fitness habits. Documentaries will also engage students in the more complex vocabulary and insight into the human body and food industry by showing them footage studies and scientific research.

Teaching Strategies: Exploration of New Material

Class debates and group discussions will synthesize a student's understanding of class notes, articles, short films, and documentaries. After reading controversial or conflicting articles, students should have the opportunity to talk through the concepts of diet and fitness that most affect their own lives.

Explicit vocabulary exercises will test each student's memory and high-order engagement with the human anatomy and common nutritional needs. Students who master the specific vocabulary of each mini-unit should produce more persuasive arguments and written work. Students who grasp the material and develop a passion for nutrition and exercise can become community and school advocates through volunteer work or the formation of a health, fitness, or well-being club.

Human Anatomy

Ancient Egyptians were the first culture to record studies of the human anatomy dating back to the 3rd century BC. The Ancient Egyptian practice of mummification involved two stages: embodiment of the deceased and wrapping of the body. The first process had the most influence of anatomical future anatomical studies. After the body was washed with sweet-smelling palm, the Egyptians would make an incision and begin to remove the internal organs. Students may relate to this process through a discussion of frog, mouse, or insect dissections. The Ancient Egyptians made the world aware of the decomposition of important internal

organs of which other civilization may not have been aware. Later, in the 5 th century BC, Greek physician Hippocrates continued to advance the world's knowledge of the human body.

While the study of the human anatomy in the Middle Ages and Renaissance period in Europe focused on idealizing specific body parts, shape, and form, 20 th century medical scientists moved towards deeper understanding of the different systems of the body [7]. Location, composition, and function are the three lenses at which we study and compare different systems within the body.

The Skeleton System

The human skeleton is the support system of the human body. Without the skeletal system human beings would not stand erect. Although we cannot see the skeletal system, it has a huge effect on physical activity. The human skeleton is located underneath the layers of skin, fatty tissue, and muscular fibers. Most sources conclude that the average adult has 206 bones that make up the entire skeleton. Bones take on a variety of shapes, sizes, and functions. At birth, infants can have almost 300 bones in their bodies. These bones fuse together over time and create the adult skeleton.

In total, the human skull is made of 29 bones that are fused together to protect the brain. The face makes up 14 of these bones. Each human hand has 27 bones and the wrist consists of 8 bones. Each foot and ankle combines to add another 26 bones. The breastbone and ribs serve a similar protective function: they keep the heart and lungs safe from pressure and impact. Bones in the arms, shoulders, torso, and legs are important because they serve a function of movement. Stronger bones can move more quickly and more powerfully against tension.

Most bones have three layers: periosteum, hard bone, and a spongy core. Periosteum is the outer layer of bone. The second layer of bone is the strongest and hardest part of the skeleton. This hard bone encloses the softer, lighter spongy center. Since the periosteum is made of cells that repair broken bone, bones heal themselves on the outside first. Almost all bones are made from a cartilage precursor. The cartilage forms collagen fibers that create a tough, yet flexible bone material [8]. However, the clavicle and top of the skull are made from connective tissue that is not comprised of cartilage.

The breastbone, hip, and vertebrae of skeletal system are made primarily of spongy bone. Spongy bone in young people is strong but light in weight. As a person ages, some of the spongy bone in the body loses calcium and may become thin, and fragile. The elderly and adults who do not take in enough calcium are susceptible to breaking their hip because of the natural process of calcium depletion.

The major bones in the hip and leg are connected at joints. Joints represent pockets where cartilage, soft tissue, protects two bones from rubbing against one another. The head of the femur fits comfortably into the side of the pubis. The patella (knee cap) is attached to both the femur and upper tibia (lower leg bone) by the patella tendon. In the lower leg, the tibia is the weight-bearing bone. The fibula serves primarily as an attachment for muscles. As a result, the fibula does not grow to be as big or as strong as the tibia. Children who engage in sports and high impact activities are likely to develop bigger and stronger bones because high-tension (think running and jumping) can increase bone growth.

Students may enter this unit with an understanding that joints are formed where two or more bones meet. Joints allow bones to move; however, ligaments are the strong fibers that keep everything together while giving us the flexibility and dexterity to move. Joints, however, take on many different formations. Ball and socket joints allow bones to move in many different directions. Hinge joints allow either vertical or horizontal movement (but not both), and pivot joints allow for one bone to swivel around the other [9].

Ball and Socket Joints	Hinge Joints	Pivot Joints
Hip	Elbow	Neck
Shoulder	Knee	
	Ankle	

What facts should students know about the skeletal system?

§ How many bones are in the adult skeleton? (206)
§ How many bones are in each hand? (27)
§ How many bones are in each foot? (26)
§ How many bones are in the hands and feet combined? (106)
§ How many bones are in the adult skull? (28)
§ How many bones are in the face? (14)
§ How many bones are in each ear? (3)
§ How many vertebrae are in the adult skeleton? (26)
§ How many bones are in the shoulder? (2)
§ What is the most frequently fractured bone in the body? (Clavicle)
§ How many bones are in the upper leg? (1)
§ How many bones are in the lower leg? (2)
§ What is the longest bone in the body? (Femur: thigh bone)
§ The femur makes up approximately what percent of body height? (1/4 or 25%)
§ What is the smallest bone in the body? (Stirrup: ear bone)

Math Activity – Skeletal System Calculations

Remember that the femur is approximately one-forth of a person's height. Students should be able to use the following equations to fill in the missing measurements. (Round answers to the nearest unit). Students will begin by calculating the length of the femur given the height of the person, then they will use the reverse formula to find the height of a person given the length of the femur.

Mass of femur = (Total mass of person) / 5

Total mass of person = (Mass of femur) x 5

Height of Person	Length of Femur		Length of Femur	Height of Person
60 inches			16 in	
52 inches			17 in	
72 inches			18 in	
6 feet 5 inches			19 in	
5 feet 3 inches			20 in	
5 feet 10 inches			21 in	
250 cm			22 in	
300 cm			1 foot 5 inches	
180 cm			1 foot 6 inches	

Math Activity – Foot to Height Ratios

Background Information

The height of a person's femur is a good predictor of a person's height. Similarly, the length of a person's foot reveals something about that individual's height. Pretend you are a forensic anthropologist trying to figure out the approximate relationship between foot length and a person's height.

Data Collection Process

Students should work in teams of two to three to collect data on the foot length and height of as many of their peers, family members, and teachers as possible. Students must create a spreadsheet to fill in an individual's name, height, and foot length. Any subject who declines to give their name but is willing to participate can write "anonymous" under that section. Foot length should be measured from the back of the heel to the tip of the big toe.

Math Activity – Crime Scene Investigation

Description of Crime

At approximately 11:15 p.m. last night, the New Haven Police were called to investigate a crime scene outside the playground of Roberto Clemente Leadership Academy. Upon arriving at the scene, the police investigators noticed two separate piles. The first pile contained an assortment of burned clothing—everything from hats to sneakers, to sweatpants, to what looked like a leather jacket. The other pile contained a variety of bones. The bones were all different shapes and sizes. For hours, the police search the neighborhood for clues and witnesses. To their dismay, the only person who provided any information was the old man walking his dog who called 911 in the first place. There are no witnesses. Without witnesses or an intact body, there were no suspects.

Student Directions

At this time, there are no suspects connected to the crime scene. Missing person reports take 24 hours to file, so a potential list of victims will not be available until after 11:15 p.m. tonight. The police need you help. Please use what you know about the femur and foot bone lengths to help the police figure out the possible ages and heights of the victims.

Teacher Instructions

Split the class into groups of three or four students. Provide each group with a box or bag of bone cut outs. There should be at least one femur bone or one intact foot for every victim to give students enough information to determine the number of victims, approximate height of each victim. Students can be creative with the ages and individual characteristics of each victim. The purpose of the activity is not for students to necessarily solve the crime, but for them to use what they know about foot length and femur length and height to create a profile for the victims. The number of victims, actual bone sizes, and items found at the crime scene is at the discretion of the teacher's creativity.

The Muscular System

Overview

There are over 600 muscles in the human body; each is made of small fibers that come together to form a person's shape and definition. Typically, the muscular system itself represents about 40 percent of an adult's weight [10]. That figure can be 5-10 percent less for children or higher in Olympic and professional athletes. Muscles are attached to the human skeleton by thick chord-like tendons. Muscles contract to perform movements. All movements involve a contraction of one or several muscles. When muscle tissue contracts it shortens, allowing a variety of motion [11]. Running, jumping, brushing your teeth, and even smiling involve the contraction of muscle tissue. Thus, muscles contractions throughout the body are responsible for walking, running, and lifting objects. Muscles in the face are responsible for facial expressions and eye movements. Increasing muscular fitness helps with joint stability, posture, and bone density. Strong, flexible muscles allow

people to perform more complex movements and physical tasks without increasing their risk of injury. Students might also find it interesting that muscular contraction uses energy to create heat.

Types of Muscle

There are three types of muscles in the human body: skeletal, smooth, and cardiac. Each type of muscle is formed by protein synthesis. The fibers that make up muscles are developed through forced contraction. Protein helps restore muscle mass and strength. Skeletal muscle attaches to the bone and exist throughout the entire body. Smooth muscle is found in the walls of the digestive tract and blood vessels. It is not under voluntary control. Cardiac muscles can only be found in the walls of the heart.

Muscle Terminology & Size

While most muscular names and terminology originate from Latin or Greek roots, many muscle names are based in mathematical roots that describe their structure, function, or size [12]. The names *maximus* and *longus* refer to a large or long muscle respectively. Conversely, a muscle with either *minor* or *brevis* in its name describes a muscle that is small or short. The deltoid, or outside shoulder muscle, is shaped like a triangle. The trapezius, upper shoulder muscle, is cleverly shaped like a trapezoid.

Location & Origin

With teacher assistance, students should be able to dissect long names in the muscular system to determine their location. Names such as intercostal should be broken into their prefix and root. For example, *inter* means across and *costal* means ribs [13]. Therefore, the intercostals muscles run between the bones of the rib cage. The word *ceps* means head. A prefix added on to *ceps* can also inform a person of the number of origins or heads that muscle has. For instance, the biceps and triceps of the upper arm have two and three origins respectively [14]. Meanwhile, the quadriceps femoris has four origins. The word femoris tells us that the quadricep muscles are related to the femur of the skeletal system. Thus, the ability to memorize skeletal structures and their given names will greatly help students to explore and breakdown complex terminology in the muscular system.

Direction of Fibers

Muscle fibers stretch in different directions to help us navigate our world. Different muscles are responsible for bending, twisting, lifting, pushing, or pulling. Each muscle in the body has one primary function and one or two secondary functions. The study of muscle direction is relative to the midline of the body [15]. Students may have a good grasp of what it means to be parallel or they may need to relate this concept to a horizontal plane. Having students move around and perform small exercises to test directional movements is an appropriate teaching method. *Transverse* muscle fibers in the body are perpendicular to the midline. The transverses abdominis in the abdomen is an example of a muscle that contracts at a right angle to the midline of the body. The obliques, side muscles in the stomach, do not move in a straight line perpendicular to the midline. Instead, the obliques contract diagonally in comparison to the body's midline. The rectus abdominus, known to many students as the "six pack" muscle, runs parallel to the midline.

Skeletal Muscle

Skeletal muscle is the longest type of muscle in the human body. Students will be familiar with these as the primary muscles in their body. Skeletal muscle is responsible for voluntary motion. We consciously decide to

move our arm to lift an object. We knowingly move in a specific direction. Students need to learn that skeletal muscle fibers are strong, but have very little endurance. Skeletal muscle can be trained to become more powerful and gain greater endurance. Running, cross training, and weight lifting are the most common ways of creating stronger skeletal muscle. A cross-section of skeletal muscle will show students that muscle fibers do not simply rest side by side. Skeletal muscle is an intricate bundle of fascicles and connective tissue called perimysium [16]. A sheath, the epimysium, wraps and protects the bundle of fibers and connective tissue to complete the muscle composition. Tears or strains in skeletal muscle can be painful and may require treatment with ice and rest to heal.

Skeletal muscle fibers that contract quickly tend to fatigue quickly. Higher contraction speed is associated with less endurance. More endurance is associated with slower twitch. While the average adult has 50-60% fast twitch muscle fibers, the body of professional sprinters may contain higher than 80% fast contracting fibers [17]. Although people are born with specific distributions of fast and slow twitch muscles, exercise can increase their resistance to fatigue.

Math Activity – Angles of Contraction

Present the concept of muscular flexion and decreasing arm angles by presenting students with pictures of the bicep, forearm, and wrist at various points through the curling motion. Have students measure the angle created by the bicep and forearm in each picture. Students will need a pencil and protractor in order to accurately measure the different angles. Students should be able to measure the angle and label it as straight, obtuse, right, or acute. Finally, students will gain exposure to the fixed point in a pulley system. The fulcrum is the scientific term for the point, or joint, around which bones move.

The Cardiovascular System

Overview

The cardiovascular system consists of arteries, veins, capillaries, and lymph vessels. These internal body parts send oxygen, blood, and other nutrients throughout the body cells, muscles, tissues, and organs. In other words, the cardiovascular system is responsible for blood flow throughout the human body, thus earning its nickname as the circulatory system. It allows all of the other systems in the human body to work together. In addition to sending nourishment to the proper areas of the body, the cardiovascular system aids the digestive system in waste removal.

Blood Vessels

Arteries, veins, and capillaries are the three main types of blood vessels in the human body. Arteries take blood away from the heart and push it out to the rest of the body, veins bring blood back to the heart, and capillaries connect arteries and veins.

The human body is full of trillions of tiny cells that float around in tissue fluid [18]. Cells stay alive and healthy by taking oxygen and nutrients from the tissue fluid. Blood vessels act as guides creating pathways for blood to flow from the heart to the rest of the body. Blood must travel smoothly everywhere from our hair to our toenails and from the cornea of our eyes to the enamel in each of our teeth [19]. In this way, the cardiovascular system is responsible for replenishing tissue fluid throughout the body with new nutrients and fresh oxygen. If waste and toxins are not removed from cells on a regular basis, then the cells become poisoned and die. It is the role of white blood cells to find and kill bacteria and viruses before they infect the body [20]. White blood cells are one of the most important players in the circulatory system because they prevent bodily infections that have the potential to become life-threatening diseases.

The Heart

The human heart is the central organ in the cardiovascular system. The heart is split into two sides. The right side of the heart pumps all blood that lacks oxygen to the lungs where blood cells receive new oxygen to carries throughout the body. Then the left side of the heart pushes the new oxygen in the direction of vital organs. When the organs have consumed most of the oxygen, veins coming from each organ carry the blood to the superior and inferior vena cavae. The superior and inferior vena cavae return the blood into the right side of the heart where it travels to the lungs once again [21].

Cardio-acceleratory Center

The cardio-acceleratory center, located in the brain, speeds up heart rate during exercise or stressful moments. It is necessary for the heart to circulate oxygen at a faster rate during exercise and stress because muscles need oxygen faster in order to perform at their peek. The cardio-acceleratory center works through the sympathetic nervous system.

Cardio-inhibitory Center

When a person is at rest, the cardio-inhibitory center, also located in the brain, works with the parasympathetic nervous system to slow the number of heartbeats per minute.

Instability Within the Cardiovascular System

If the cardiovascular system fails, serious problems can occur. A heart attack involves a shortage of oxygen supply to the heart. This often happens when the coronary arteries becomes partially blocked. A mix of fat and cholesterol is the most common form of plaque build up to block the arteries and stop blood flow to part of the heart muscle. In addition, fat buildup that blocks the cerebral arteries can also affect blood flow to the brain. If there is a shortage of blood flow to the brain, there is a very sudden change in brain activity. This is called a stroke. Symptoms of a stroke include: sudden paralysis to one side of the body, loss of sensation, loss of speech, vision impairment, confusion, or disorientation. A stroke is a very serious medical emergency. Anyone who seems to be having a stroke must be taken to the hospital.

Common Causes of Cardiovascular Diseases

Poor eating habits are a factor in developing a cardiovascular disease. Eating too much fatty food increases a person's chance of building up plaque that can block blood flow to coronary arteries. Lack of exercise is another major lifestyle choice that affects the cardiovascular system. A lack of sufficient exercise can weaken the heart. It can be strengthened just like skeletal muscles.

Type-1 Diabetes

Loss of insulin secreting cells in the pancreas causes Type-1 diabetes. This is referred to as juvenile onset because it strikes children.

Type-2 Diabetes

Type-2 diabetes is caused by a loss of insulin receptors and some insulin secreting cells. This form of diabetes is called adult onset. Too much sugar in the diet leads to too much blood glucose. High, unregulated blood glucose is the biggest risk factor for Type 2 Diabetes.

Thyroid Gland

The Thyroid gland is responsible for controlling the body's metabolic rate. It helps regulate both the work rate of the heart and the nervous system. The thyroid releases a hormone that either speeds up or slows down the rate of chemical reactions and transmission of nerve impulses inside the body [22]. Thus, the thyroid gland is involved in muscle contraction during physical activity and workouts as well as preventing blood clots. The final duty of the thyroid gland is to regulate the amount of calcium in the bloodstream. The rate of release of calcium from bone is controlled by the thyroid gland [23].

The American Diet

In 1970, the U.S. food system calculated that the average American consumed 2,168 calories per day. The breakdown of calorie intake by category was: 402 from added sugar, 410 from added fat. Thus, 812 calories or 37 percent of the American diet came from additives, unhealthy calories.

In 2008, the U.S. food system reported that Americans were now consuming and average of 2,673 calories per person per day. This powerful evidence that the cheap-food policy instituted by Nixon-era USDA chief Earl Butz was a huge success from the standpoint of policy makers. However, the nation now faces a vast healthcare crisis. The intense production of corn, soy, and processed goods made food more affordable, but Americans are paying the price for eating what is cheap and affordable. Over the past 40 years, calorie intake has increased by more than 23 percent. Americans are eating more and not exercising enough to burn off the extra calories. The 2008 average calorie consumption for added sugar and added fats climbed to 459 and 641 calorie respectively. Thus, 1,100 calories or more than 41 percent of the average American diet contained sugars and fat.

From 1970 to 2008, healthy protein consumption (meat, eggs, and nuts) only increased 4 percent. In 1970, the average American ate 463 calories of protein. The 2008 food system data reported that the American diet now contained roughly 482 calories of protein.

Students can use this full interactive chart to compare the diets of Americans in 1970 to 2008. They

interactive chart changes numbers every two years. Students can use this data to make a line graph with two-year intervals on the x-axis.

http://civileats.com/2011/04/05/where-do-americans-get-their-calories-infographic/

Caloric Intake By the Numbers

Year	Fat	Sugar	Carbs	Dairy	Protein	Total
1970	410	402	627	267	463	2,168
1974	406	397	618	257	459	2,138
1978	418	409	645	255	460	2,187
1982	426	397	662	248	449	2,183
1986	493	419	734	263	467	2,377
1990	461	446	784	260	453	2,405
1992	489	459	805	260	461	2,473
1996	478	487	855	258	457	2,536
2000	615	507	863	259	479	2,717
2004	653	478	853	259	496	2,721
2008	461	459	833	257	482	2,673

Students should be able to create, read, and interpret a chart of caloric intake using the

data from civileats.com. Discussion of the data should lead students to notice the following trends:

§ The large increase in total daily calories consumed by the average American from 1982 to 1986
§ Total daily caloric intake peaked in 2004

Caloric Intake By Percentages (Rounded to the nearest percent)

Year	Fat	Sugar	Carbs	Diary	Protein	Total
1970	19%	19%	29%	12%	21%	2,168
1974	19%	19%	29%	12%	21%	2,138
1978	19%	19%	29%	12%	21%	2,187
1982	20%	18%	30%	11%	21%	2,183
1986	21%	18%	31%	11%	20%	2,377
1990	19%	19%	33%	11%	19%	2,405
1992	20%	19%	33%	11%	19%	2,473
1996	19%	19%	34%	10%	18%	2,536
2000	23%	19%	32%	9%	18%	2,717
2004	24%	18%	32%	10%	18%	2,721
2008	17%	17%	31%	10%	18%	2,673

Students should be able to calculate the percentage of total daily intake for each food category (see below). Students can then analyze trends and point out the year of minimum and maximum percentages for each category. Overall, students should be aware that fat and carbohydrate intake increased from 1970 to 2004 while protein intake decreased. The year 2008 marks the beginning of a national awareness to the issue of obesity and proper nutrition in the country. Thus yielding a 7% decrease in the percentage of fat in the daily diet. Looking at eating habits next to trends in exercise will give a more accurate picture of a person's overall health.

$$\text{Percentage of total diet} = \frac{\text{Amount of Food}}{\text{Total Amount}} \times 100$$

Below is an extension activity for students who have already mastered the ability to chart data and calculate percentages. The online website (Civil Eats) allows students to breakdown carbohydrate intake into three separate categories: grains, vegetables, and fruit. Students can fill in a blank chart and calculate the percentage of calorie intake relative to each category.

Year	Total Carb Intake (calories)	Amount of Grains	% of Grain	Amount of Fruits	% of Fruits	Amount of Veg	% of Veg
1970	627	432	69%	70	11%	125	20%
1980	662	464	70%	81	12%	117	18%
1990	784	573	73%	85	11%	126	16%
2000	863	634	73%	94	11%	135	16%
2008	833	625	75%	86	10%	122	15%

Importance of Nutrition

Nutritionists throughout the United States recommend children eat 2 ½ cups to 6 ½ cups of fruits and vegetables a day, 2-3 ounces of whole grains, and 1,500-2,300 mg of sodium each day. Currently, children eat less than recommended amount of fruits, vegetables, and whole grains. At the same time, they eat more than 2,300 mg of sodium [24]. Calories from added sugars often come from soda, fruit drinks, dairy desserts, pizza, and whole milk. Yes, french fries come from baked potatoe, but it is the combination of fat carbohydrates, and chemicals put in processed foods that "pollute" our diets [25].

Cholesterol & Fat

Cholesterol is a tricky subject. Fun fact: about 25% of the cholesterol in the human body comes from meat and eggs [26]. The liver makes cholesterol from carbohydrates, proteins, and fats. We need cholesterol to support the cells in our body and digest fats. However, too much cholesterol can block arteries and prevent blood from flowing to the heart and brain [27]. Therefore, high blood cholesterol is one of the biggest risk factors for long-term health problems, especially heart disease.

Water

Water is made of two hydrogen molecules and one oxygen molecule. Water is the most important part of human diet. Water helps carry nutrients and oxygen to your cells. It helps convert food to energy, cushions and protects vital organs in the human body, and helps the intestines digest and absorb nutrients into the body. Water is also involved in removing waste from the body. It regulates body temperature and helps our muscles maintain strength and grow in size. Not only does water compose 75% of the human brain, but it also makes up roughly 80% of blood in the body and more than 20% of bones. Without sufficient hydration, our body does not perform at peak physical or mental capacity. Both children and adults need water to live a healthy lifestyle.

Food and the Brain

We can compare food to gasoline. Food is to human beings as gasoline is to automobiles. "Just as premium gasoline make for a smoother-running car, brain-friendly foods can make for a smoother mood," says Oregon-based dietitian Elizabeth Somer [28]. For example, tomatoes and other foods that contain lots of cartenoids may

prevent depression and slow memory loss and dementia in older adults [29]. The National Institute on Aging recommends one serving (about a cup) of fresh tomatoes or natural tomato juice a day to see the full nutritional benefits of its cartenoids [30].

Whole grains and other carbohydrates promote the sustained release of insulin, rather than a sudden spike [31]. Insulin is the hormone in the human body that stimulates the production of serotonin. Whole grains are preferred to processed starches because they carry less simple sugars. Whole-grain graham crackers or two cups of air-popped popcorn are highly recommended foods that have the ability to enhance a person's mood [32]. Dark chocolate, or any chocolate that contains at least 60 percent cocoa, has also been linked to increased serotonin levels and mental alertness [33].

Calories

A calorie is the unit of energy used to measure how much substance food has. Think about a calorie as the amount of fuel a car gets from gas. Denser foods have more calories and provide more energy just as diesel gas gets better engine mileage than regular unleaded. While our body needs calories to exercise, function, and ultimately survive, it is important not to overeat. Calories that are not consumed by muscles to rebuild or that are not burned off in the form of energy are stored in the body as fat [34]. Student must understand the following concepts if nothing else: people gain weight if they consume more calories than they use on a daily basis and people lose weight if they consume less calories than they use on a daily basis. With proper exercise, the body first burns un-stored calories in the form of carbohydrates and fats. Next, it turns to stored fats for energy. The last resort is muscle fibers. Some literature suggests that a pound of fat is worth 3,500 unused calories [35]. Eating fewer calories alone will not make you lose fat, since some of the weight loss may come from muscle. Limiting sodium intake to 2,000 milligrams per days is also recommended to avoid fluctuations in water weight and high blood pressure.

Net Calories = Calories Consumed – Calories Burned

Basal Metabolic Rate

Basal metabolic rate (BMR) is the number of calories the body uses to "run" its normal functions. BMR can be calculated using the following formulas. People who want to gain healthy weight and muscle mass should multiple their calculated BMR by 1.2 to find the number of calories to eat per day alongside a proper workout routine. People who want to lose healthy weight should decrease their net calorie intake by approximately 500 calories per day [36]. The following formulas were adapted from Beilenson's *Pocket Carlorie Counter.*

Women:

BMR = 655 + (4.4 x weight in pounds) + (4.7 x height in inches) – (4.7 x age in years)

Men:

BMR = 66 + (6.2 x weight in pounds) + (12.7 x height in inches) – (6.7 x age in years)

Healthy Food Choices

Item	Food Group	Servings	Protein	Carbs	Total Fat	Sodium	Calories
Cheerios	Starch	1 (1 cup)	3 g	21 g	2 g	186 mg	103
Strawberries	Fruit	1 (8 berries)	1 g	30 g	1 g	2 mg	120
Skim Milk	Dairy	1 (1 cup)	8 g	12 g	1 g	127 mg	89
Whole-Grain Bread	Starch	2 (2 slices)	6 g	30 g	2 g	300 mg	162
Turkey (deli)	Protein	2 (4 oz)	28 g	0 g	0 g	1432 mg	112
Breyers, Fat Free Vanilla	Dairy	1 (1 cup)	6 g	42 g	2 g	102 mg	184

Unhealthy Food Choices

Item	Food Group	Servings	Protein	Carbs	Total Fat	Sodium	Calories
Cocoa Krispies	Starch	2 (1.5 cups)	4 g	54 g	2 g	197 mg	236
Whole Milk	Dairy	1 (1 cup)	8 g	11 g	8 g	98 mg	146
Bacon	Protein	1 slice	3 g	0 g	3 g	192 mg	42
Potato Chips	Starch	1 oz	2 g	15 g	10 g	168 mg	152
Potato Chips (salted)	Starch	1 oz	2 g	15 g	10 g	2 mg	152
Snickers		1 bar	4 g	35 g	14 g	140 mg	271
Soda (Cola)		1 (16 fl oz)	0 g	52 g	0 g	20 mg	201
Ben & Jerry's Reduced FatVanilla	Dairy	1 (1 cup)	6 g	32 g	10 g	130	220

Calories Expended

Muscle contractions create energy and heat. Calories are burned at different rates depending on the frequency, duration, and intensity of activity. Factors that are less controllable include body weight and metabolic rate, yet they both play a very important role in calculating the calories a person expends, or burns off, during exercise. Students can visit http://www.nutristrategy.com/caloriesburned.htm to find an extensive list of activities, exercises, and strategies accompanied by the approximate number of calories each activity

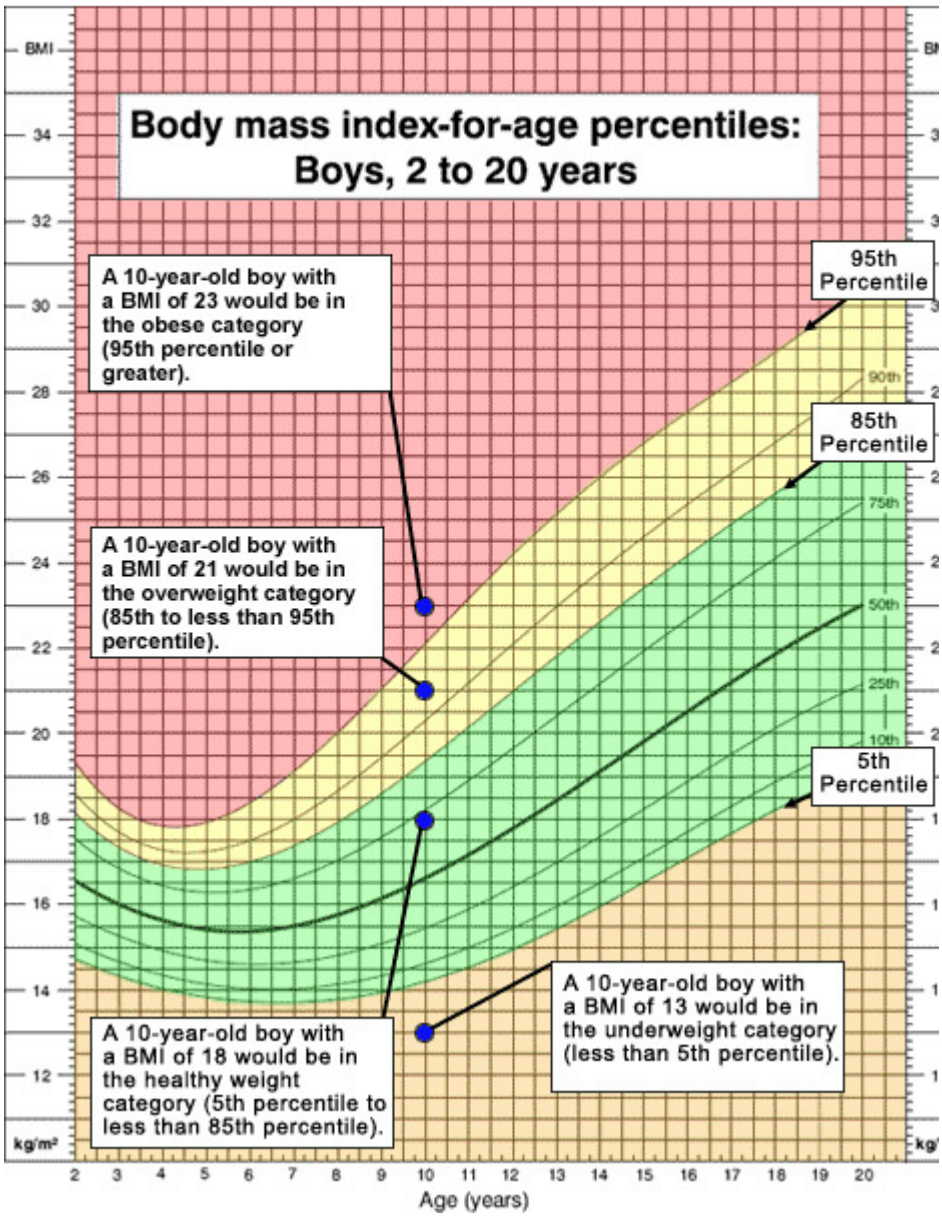
burns in an hour. The following chart includes exercises that might appeal to middle school students.

Approximate Calories Expended (per hour of constant activity)

Activity	105 lbs	130 lbs	155 lbs
Pushups or sit-ups (slow pace)	145	205	245
Pushups or sit-up (fast pace)	380	470	560
Running (12 minute mile pace)	380	470	560
Running (sprints)	480	590	700
Basketball (game)	380	470	560
Basketball (shooting)	185	250	315
Bowling	150	180	210
Boxing (punching bag)	275	350	425
Football (game)	430	530	630
Martial Arts	475	590	705
Jump Rope (fast)	575	710	845
Jump Rope (slow)	380	470	560
Skateboarding	240	295	350
Soccer (game)	370	420	490
Squash	575	710	845
Walking (conversation pace)	200	240	280

Body Mass Index

See the following example of how some sample BMI numbers would be interpreted for a 10-year-old boy.



The measure for determining a person's weight category is called the Body Mass Index. Doctors and physical trainers use a standard BMI chart to label a person as underweight, normal weight, overweight, or obese. The BMI is a simple comparison of a person's metric height and weight. The purpose is to gain a basic measurement of body fat based on the two characteristics. A BMI under 18.5, "underweight," tells doctors that someone has very little body fat or muscle. The "normal weight" category represents a BMI of 18.5 to 24.9. Overweight persons have a BMI of 25 to 29.9. And "obesity" is the category for persons with a BMI of 30 or greater. Persons falling in the obese category are at higher risk of diseases that may occur with more body fat [37] . High BMI levels increase a person's risk for heart disease, problems related to high blood pressure, type 2 diabetes, respiratory problems, and even certain cancers. On the other hand, the BMI is very simple and is criticized for overestimating body fat in athletes. For example, a body builder or athlete is going to weight a lot more than a sales associate or a professor who is the same height. The BMI might label this athlete as obese even though he or she is perfectly healthy and probably in better shape than the other person. Conversely, BMI calculations may give the impression that an elderly person, who has lost a lot of muscle

mass, has less body fat [38].

Before implementing teaching strategies for introducing the Body Mass Index to elementary students, teachers must have a serious discussion about obesity to prevent any teasing, mocking, or embarrassment of students who may be unhappy with their body mass index. Students should keep their height and weight measurements to themselves to avoid unhealthy competition.

Math Activity – Create a Graph Using BMI Data

Students can visit http://www.nhlbisupport.com/bmi/ to find their exact BMI measurements. Next, guide students in the process of finding BMI measurements for various heights and weights across. Students may use Microsoft Excel to create a chart that contains at least 20 measurements. The purpose is not for students to recreate the BMI chart. The activity is designed for students to become comfortable collecting data and organizing data in a table using Excel. Next, students can highlight their tables and create a bar graph or line plot to display the Body Mass Index measurements of the data they created. Students may then compare graphs and determine who came up with the most obese or most in shape group of people. Use or recreate the template below to help students create an appropriate table.

Height (inches)	Weight (pounds)	BMI

Lessons

Vocabulary: Week 1

Muscle

Muscle – bundles of stretchy fiber that shorten (contract) and relax (extend)

Voluntary muscle – muscles a person can use to control, arms, legs, chest, back. Attached to the human skeleton

Involuntary muscle – muscles you cannot control, heart, digestive muscles

Tendon – a thick cord that attaches all muscle to bone

Contraction – when a muscle tightens because it is doing work

Bone

Bone – made of living cells, blood vessels, calcium, and nerves, hard, spongy core

Periosteum – outer shell of bone, surrounds the core, made of cells that can replace and repair broken bone

Blood cells – made inside marrow

Marrow – soft jelly-like substance found inside large bones, produces millions of red blood cells every day

Synovial Joint – when two bones meet to form a moveable joint

Ligaments – a specific type of cartilage, elastic fibers that hold two bones of the joint together

Cartilage – elastic fibers, protect bones from wearing away or rubbing against each other

Vocabulary: Week 2

Movement

Abduction – movement of a bone away from the midline of the body

Absorption – when the body takes nutrients into the bloodstream

Adduction – movement of a bone towards the midline of the body, the opposite of abduction

Antagonist – a muscle that works opposite another muscle when an action is performed (e.g. the tricep is the antagonist when an athlete performs a bicep curl)

Cardiovascular System

Veins – blood vessels that carry deoxygenated blood to the heart

Arteries – blood vessels that carry blood away from the heart

Capillaries – microscopic blood vessels that connect the complex network of veins to the network of arteries

Adrenaline – a hormone that increases metabolic and heart rate. Creates a moment of extreme energy

Vocabulary: Week 3

Nutritional Needs

Caloric intake - total number of calories a person eats over the course of a day

Life expectancy - the average number of years a person lives

Water - a molecule that contains one oxygen and two hydrogen atoms, water represents 45-60% of the human body

Protein - essential nutrient that is important to your health, made out of amino acids

Carbohydrates - organic compound of carbon, hydrogen, and oxygen, carbohydrates provide the human body

with energy, carbs can turn into fat if not burned off

Sugar - sweet-flavored substance used in many foods to make them taste better, lots of sugar is not good for the body

Fat - fatty tissue and oils that do not dissolve in water. High fat diets are associated with disease.

Food groups

Fruits - fruits are naturally growing substances, they represent good carbohydrates that burn slowly in the body

Grains - carbohydrates such as breads, cereals, rice, pasta

Dairy - carbohydrates that have a higher protein content such as milk or cheese

Vegetables - good carbohydrates that are naturally growing and provide many nutritional needs

Proteins - meat, fish, nuts, fuel for your muscles

Minerals

Iron – present in all cells of the body, commonly found in meat and poultry

Zinc - increases appetite, a lack of zinc in the body can cause anorexia

Vocabulary: Week 4

Physical Fitness

Body mass index – comparison of weight and height

Height - length from your feet to the top of your head, measured in centimeters, feet and/or inches

Weight - how much mass a person's body contains

Percentile -comparison of one person to the total human population, nth percentile means a person is taller than n% of people for a given age group

Lean - lacking fat

Vocabulary: Week 5

Exercise

Metabolic rate – the rate that chemical reactions take place inside the body

Heart rate – quantifies the number of heartbeats per minute

Blood pressure – pressure in arteries during and between heartbeats

Hypertension - high blood pressure

Energy – measured in calories burned or consumed

Calories burned – the number of calories expended during exercise or physical activity

Moderate intensity – a workout rate at which you could hold a conversation

Vigorous intensity – a workout rate with very little rest in between sets and reps

Miles per hour – a ratio between miles and hours

Aerobic workout – low intensity physical activity, using oxygen

Low impact aerobics – good for your heart

High impact aerobics – good for your bones

Anaerobic workout – short during, high intensity physical activity, calls upon muscle endurance instead of oxygen flow

Muscles-trengthening activities – activities that breakdown muscles, muscles repair themselves and grow back stronger, mass increases over time

Bone-strengthening activities – impact and tension promotes bone growth

Pace – the rate at which a person is doing work

Balance – using muscles and bones in inner ear to stabilize the human body

Stretching – increases length and decreases tension inside muscles

Total Energy Expenditure – rate of expenditure multiplied by the total workout time

Writing Prompts

1) Identify two problems with the American diet.
2) Why does eating less food not solve the problem for many American children who want to lose weight?
3) What is at stake for young children and adults who are obese?
4) Name one of the two cardiovascular diseases we have studied that result from plaque buildup in arterial areas. Explain what the disease is and how it affects the human body.
5) What are several ways to help prevent cardiovascular disease?
6) What does it mean to have a healthy body weight? You may discuss the Body Mass Index (BMI) in your answer?
7) Do you know anyone who has had diabetes? Please discuss this person's symptoms and relate them to your studies of diabetes and insulin regulation.
8) Why is too much glucose bad?
9) Why is it important to drink milk or eat foods that are high in calcium? Be sure to compare and

contrast why children and adults both need calcium in their diet.
10) Why is the Body Mass Index (BMI) not a perfect measure of a person's physical fitness? Think about the BMI of professional athletes. Discuss the legitimacy of using one fixed scale to compare the bodies of children, adults, and athletes alike.

Learning Scenarios

Title: "What does BMI really tell us about a person?

Topic: Calculating Body Mass Index

Objective: Students will use the Body Mass Index chart to calculate the BMI of their favorite professional or Olympic athletes. Then, students will compare and contrast the BMI categories of athletes that play different sports. This activity is meant to encourage students to look past the numbers. We cannot measure physical fitness solely based on numbers and simple calculations. Students should be able to use their knowledge of the limits of the BMI scale to explain in detail why most football players, basketball players, sprinters, and body builders are not unhealthy or "overweight" despite their high BMI. Additionally, students should be able to explain why some soccer players are in great shape even though they may have a very low BMI. What does BMI tell us about athletes if it does not give us an accurate measurement of their body fat? A low BMI allows physical trainers to more carefully monitor athletes for dehydration. Doctors are careful to check the blood pressure and heart rate of athletes with a high BMI.

Title: "You Are What You Eat!"

Topic: Comparing the diets of two professional athletes: Ray Allen and Michael Phelps

Objective: As a class, take a close look into articles releasing the diets of NBA star Ray Allen (http://www.healthcentral.com/obesity/c/59238/113384/celtic-basketball) and Olympic Gold Medalist Michael Phelps (http://www.foxnews.com/story/0,2933,403803,00.html). More important than the diets themselves, students should be able to explain how both athletes maximize their caloric intake through intense workout routines. Michael Phelps is able to maintain a 12,000 calories diet because he spends upwards of 8 hours per day training—he only has to perform occasionally at his peak. Ray Allen, on the other hand, maintains an equally powerful diet in a couple thousand calories. Ray must be more careful about when he eats certain foods because he has to perform at peak capacity three or four times in a given week.

Classroom Activities

Title: "Food Journal"

Topic: How many calories am I eating each day?

Objective: Students will keep a journal and log what they eat and how many calories they consume daily. This activity is designed to show students exactly what they put in their bodies on a daily basis. In this activity, students will record what they consume for seven straight days. They will look up the number of calories consumed in each meal and break the meal into its primary nutritional ingredients. Each day they will receive a grade for their calculations and the overall balance of their diet. Students will work together in pairs or small groups to analyze the information and discuss trends. This same information will be used to compare the diets of students at Roberto Clemente to the diets of world-class athletes and people with diabetes and other diseases and conditions related to poor nutrition. This activity will review the teaching of units, ratios, unit rates, and graphing.

Title: "Activity Journal"

Topic: How many minute of activity am I doing each day & how many calories do I burn in a day?

Objective: Students will learn the importance of daily physical activity. They will learn that exercise not only makes you feel better, but also helps with memory, mood, and brain function. Students will develop and share strategies for finding time and space to practice different forms of exercise and physical activity.

Title: "Blast Off Game"

Url: http://www.fns.usda.gov/multimedia/Games/Blastoff/BlastOff_Game.html

Objective: Students will follow the instructions of an interactive computer game to explore healthy food choices and balanced meals. The objective of the game is for kids to reach Planet Power by fueling their rocket with food and physical activity. "Fuel" tanks for each food group help students keep track of their meals and food choices.

Title: "Choose Your Plate"

Topic: Healthy Meal Choices

Objective: Given a blank template of a plate, students use their new knowledge of nutrition to create a meal that incorporates the five main food groups and a healthy ratio of carbohydrates, proteins, and fat.

Title: "Healthy Eating Chart"

Topic: Healthy Meal Choices

Objective: Students will create a healthy eating chart or "cheat sheet" for their 1st grade reading buddies. Students will include their favorite food choices for each food group and a suggested number of servings.

Websites for Students

http://www.healthstatus.com/calculate/body-fat-percentage-calculator/

http://www.bmi-calculator.net/body-fat-calculator/

http://www.kidshealth.org/kid/htbw/muscles.html#

http://www.mayoclinic.com/health/exercise/SM00109

http://kidshealth.org/kid/index.jsp?tracking=K_Home

Short Films & Documentaries

Title: "Super Size Me" (2004)

Objective: Students will watch the short documentary and answer guided questions using their own words and interpretations of the film.

Students will use relevant vocabulary to discuss the obesity and the business culture surrounding the U.S. fastfood industry.

Title: "Fat, Sick & Nearly Dead" (2010)

Title: "Food Matters" (2008)

Title: "Ingredients" (2009)

Title: "Food Fight" (2008)

Title: "CNBC Originals: One Nation, Overweight" (2010)

Title: "Killer at Large: Why Obesity is America's Greatest Threat" (2008)

Title: "How Stuff Works: Food and Beverage" (2011)

Title: "National Geographic: The Human Body" (2002)

Bibliography

Baker, Al. "As Schools Battle Obesity, Physical Education is Sidelined," The New York Times, last modified July 11, 2012, http://www.staradvertiser.com/news/20120711_As_schools_battle_obesity_physical_education_is_sidelined.html?id=162026815.

Beilenson, Suzanne. *The Pocket Calorie Counter: The Complete, Discrete, and Portable Guide for Managing Your Health* . White Plains, New York: Peter Pauper Press, Inc., 2012.

Harding, Anne. "Study Questions Benefits of Reducing Sodium," CNN Health, last modified November 9, 2011, http://www.cnn.com/2011/11/09/health/study-questions-low-sodium-diets/index.html.

Lemov, Doug. *Teach Like a Champion: 49 Techniques that put Students on a Path to College* . San Francisco: Jossey-Bass, 2010.

McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* . China: BCL Press, 2011.

Moyer, Melinda Wenner. "End the War on Fat: It Could be Making us Sicker," The Slate Group, last modified Mach 25, 2010, http://www.slate.com/articles/health_and_science/medical_examiner/2010/03/end_the_war_on_fat.html.

Silverstein, Ken. "Viewing Bodily Imperfection as a Health Problem." In S *ocial Problems Readings* , edited by Ira Silver, 51-60. New York: W.W. Norton & Company, Inc., 2008.

The Center for Consumer Freedom. "Getting Fat on Misinformation." In *Social Problems Readings* , edited by Ira Silver, 68-74. New York: W.W. Norton & Company, Inc., 2008.

United States Department of Health & Human Services. "Assessing Your Weight and Health Risk" *National Heart Lung and Blood Institute,* http://www.nhlbi.nih.gov/health/public/heart/obesity/lose_wt/risk.htm#limitations

Van de Walle, John A., Karen S. Karp, and Jennifer M. Bay-Williams, eds. *Elementary and Middle School Mathematics: Teaching Developmentally* , Seventh Edition. New York: Pearson Education, Inc., 2010.

Wood, Chip. *Yardsticks: Children in the Classroom Ages 4-14, 3 rd Edition* . Tuner Falls, Massachusetts: Northeast Foundation for Children, Inc., 2007.

Zinczenko, David and Matt Goulding. *Eat This, Not That!* New York: Rodale, Inc., 2010.

Appendix

Unit Objectives

· Engage in meaningful conversation about the human body, shape, and form
· Develop an understanding of bone formation and bone structure
· Develop recognition and understanding of muscular formation
· Appreciate the many uses of muscle
· Strategize about the most efficient and effective way to create a healthy lifestyle
· Discuss and plan a healthy diet
· Breakdown common meals and food groups into carbohydrates, fats, and proteins
· Understand the basic components of exercise
· Create a healthy and manageable fitness plan

· Recognize and understand the effects of poor nutrition and diet on the body and brain
· Create tables and graphs using Microsoft Excel
· Analyze single and double line graphs
· Manipulate Microsoft Excel charts and graphs to create linear regressions
· Solve y=mx+b equations using basic algebra skills
· Analyze hypothetical scenarios involving poor and exemplary diets
· Understand that food is the body's energy source, measured in calories
· Appreciate the relationship between healthy diet and exercise and cardiovascular risk reduction
· Convert kilograms to pounds using a simple algebraic formula
·

Common Core Standards

Ratios and Proportional Relationships

· 6.RP.1 Understand the concept of a ration and use ratio language to describe a ratio between two quantities
· 6.RP.2 Understand the concept of a unit rate
· 6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems

The Number System

· 6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants

Expressions & Equations

· 6.EE.1 Write and evaluate numerical expressions involving whole-number exponents
· 6.EE.2 Write, read, and evaluate expressions in which letters stand for numbers
· 6.EE.3 Apply the properties of operations to generate equivalent expressions
· 6.EE.4 Identify when two expressions are equivalent
· 6.EE.5 Understand solving an equation or inequality as a process of answering a question
· 6.EE.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem
· 6.EE.7 Solve real-world and mathematical problems by writing and solving equations of the form x + p = q and px = q for cases in which p, q, and x are all nonnegative rational numbers
· 6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity

Images

Description: Body Mass Index Chart

Source: http://truestarhealth.com/Notes/Images/Healthy_Eating/BMI_Chart.gif

Endnotes

1. Baker, Al. "As Schools Battle Obesity, Physical Education is Sidelined," The New York Times

2. Ibid

3. Ibid

4. Ibid

5. Center for Disease Control and Prevention

6. Ibid

7. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 10

8. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 32

9. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 44

10. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 59

11. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 60

12. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 62

13. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 62

14. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 62

15. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 62

16. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 64

17. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 67

18. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 142

19. Ibid

20. Ibid

21. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 142

22. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 130

23. Ibid

24. Center for Disease Control and Prevention

25. Beilenson, Suzanne. The Pocket Calorie Counter: The Complete, Discrete, and Portable Guide for Managing Your Health, 6

26. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 180

27. McCracken, Thomas O. *Anatographica: A Fantastic Three-Dimensional Journey into the Body* , 180

28. Eat Your Way to Happiness

29. Moyer, Melinda Wenner. "End the War on Fat: It Could be Making us Sicker."

30. Ibid

31. Ibid

32. Ibid

33. Ibid

34. Beilenson, Suzanne. The Pocket Calorie Counter: The Complete, Discrete, and Portable Guide for Managing Your Health, 7

35. Ibid

36. Beilenson, Suzanne. The Pocket Calorie Counter: The Complete, Discrete, and Portable Guide for Managing Your Health, 12

37. United States Department of Health & Human Services. "Assessing Your Weight and Health Risk" *National Heart Lung and Blood Institute*

38. Ibid