FAT…. It's Not All That: Two Main Types of Fat in Our Bodies, Visceral and Subcutaneous Fat

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Overview

In today's society, the average American is considered to be overweight. In particular, 66% of American adults are measured to have a body mass index of 25.0kg/m² or greater as an indicator of their total body fat. Similarly, 17% of 6-19 year olds are deemed overweight. These are significant statistics that scientists and health professionals alike are examining in great detail. Much research is currently being conducted on two main types of fat: visceral, which is intra-abdominal fat, and subcutaneous, defined as the layer of fat underlying the skin. Scientists are researching possible linkages to genetics and other causal factors of obesity, such as the ratio between energy consumption and energy expenditure, meal portions, sedentary environments, and the role hormones play in the body. Because trends suggest even further increases in the number of Americans becoming overweight/ obese in the years to come, this has become an important topic to research.

When attempting to decide on a topic for capstone research, I examined scientific phenomena which interested me. I considered factors that affect my daily routine and determined that one of my overarching goals in life is to maintain a healthy lifestyle. Through regular exercise and sustaining a healthy diet filled with nutritious foods, I am able to work towards accomplishing this goal. After further thought on the topic, I developed ideas on how it relates to my life as an educator.

I reflected on my students and the challenges some of them face when dealing with their weight and body shape. Many of the students whom I have taught are unaware of health risks associated with poor diet and lack of exercise. Some have misconceptions about weight loss and think that starvation is the only way to lose unwanted pounds or that they can eat whatever they want as long as they do some form of exercise. In addition, many students' only form of exercise is the 45 minute gym period they receive in school. Consequently, these factors contributed to my decision about this topic.

As a way to learn more about obesity and scientific principles which underlie it, I researched different types of adiposity, the biochemical processes of adipocytes, or fat cells, the hormones secreted by these cells, health risks associated with obesity, and its contributing factors. As well, I developed a two week unit plan on teaching middle school students how to live a healthy lifestyle. I examined common misconceptions

about obesity, nutrition, exercise, and the risks associated with poor diet and fitness. Moreover, National Science Education Standards [NSES] were outlined as they pertained to the enduring understandings of the unit. I developed inquiry activities that allowed students opportunities to explore the various aspects of what it mean to live a healthy lifestyle so that they are able to design and implement their own healthy living plan. As a culmination of the unit, students will get the opportunity to teach others in their school community what they have learned about the importance of living a healthy lifestyle and influence others to design and put into practice their own health/ fitness plans.

Abstract

Sixty-six percent of American adults are considered to be overweight or obese. Much research is currently being conducted to learn about the different types of adiposity, the biochemical processes of adipocytes, or fat cells, the hormones secreted by these cells, health risks associated with obesity, and its contributing factors. The report below will outline how to classify obesity, the hormones secreted by fat cells (leptin, resistin, and adiponectin) and how they work in the body, the two types of fat: visceral, or intra-abdominal fat and subcutaneous fat, inflammation and health conditions, studies linking genetics to obesity, and the overall contributing factors to gaining excessive weight.

Introduction

According to the 2003-2004 National Health and Nutrition Examination Survey [NHANES], an estimated 66% of adults, aged 20-74, in the United States can be classified as overweight or obese (Ogden, C., Carroll, M., Curtin, L., McDowell, M., Tabak, C., & Flegal, K., 2006). In addition, 17% of children ages 6-19 are considered to be overweight. Obesity can be defined as an excess of body fat where the size and number of adipocytes, or fat cells, increases, which typically is associated with considerable health risks (Myers, 2004). This report will define and outline obesity and its correlation to body fat content, the two main types of body fat, visceral and subcutaneous fat, and the risks associated with each. In addition, it will discuss the hormones fat cells secrete in the human body.

Defining Obesity

In order to pronounce that an individual is overweight or obese, health professionals use height and weight measurements to calculate a person's body mass index [BMI]. BMI can be described as a surrogate indicator of an individual's fat content. Although it does not measure fat directly, BMI is directly related to body fat (CDC, 2007a). BMI is defined as weight (kg)/ height $(m)^2$ (Myers, 2004). To classify adult individuals as overweight they must have a BMI range of 25.0 kg/m^2 to 29.9 kg/m^2, while an obese person is defined as having a BMI of 30.0 kg/m^2 or greater (CDC, 2007a). Although this method is a useful tool for determining overweight and obese patients, it may not be the most accurate or scientific. Some research suggests that a more precise,

non-invasive and faster instrument for measuring a person's fat content is through single-slice magnetic resonance imaging [MRI] (Morley, 2007). This type of procedure is helping to assess children and adults who are at risk for serious health complications in research projects; however, this procedure is expensive and thus not the primary method used for determining fat content. Yet, in order to use these methods and tools, healthcare specialists must first identify the types of fat which they are measuring and where these are distributed throughout the body.

Fat Facts

A fat cell, or adipocyte, stores fat as triglyceride in the body. Triglycerides are composed of three fatty acids and a glycerol molecule. Adipose tissue is comprised of fibrous connective tissue with adipocytes that provide a source of energy to the body which protect, cushion, and insulate vital organs. Adipose tissue used to be thought of as an inactive place used only to store energy to be utilized at a later time. But, in 1994 scientists discovered that specific hormones that are useful in preventing health problems actually are secreted by fat cells. Fat, in general, is now regarded as an important part of the human body and is considered to be an active and complex endocrine organ (Gosnell, 2007).

There are two types of adipose tissue known as brown adipose tissue (brown fat cells) and white adipose tissue (white fat cells). Brown fat cells are an individual's first fat cells and are primarily found in infants. These types of cells are composed of an increased number of mitochondria, which are the energy boosters of the cell, and are used in the process of thermogenesis, in order to create heat for the body (Freudenrich, 1998-2007). As an infant continues to develop, the level of brown adipose tissue decreases, while white adipose tissue increases. These white fat cells can be considered the "typical" fat cell found within the human body. These cells are usually 20-25% larger than other body cells due to their lipid content, which is primarily made up of triglycerides and cholesterol ester. They also contain a normal sized nucleus and similar amount of cytoplasm as other cells. Yet, they appear greater in size because of the globular structure of the lipid, or fat, pushing the remaining parts of the cell outward towards the cell membrane.

Fats and Hormones

As mentioned previously, fat is an important endocrine organ that secretes hormones. White fat cells are responsible for releasing the hormones, resistin, adiponectin, and leptin. Resistin is the hormone released to allow tissues to become less sensitive to the action of insulin and most often correlates to insulin resistance which leads to Type II Diabetes ("Resistin," 2006). After an individual with normal metabolism eats a meal, insulin is released by the pancreas and is transported to insulin-sensitive tissues, including adipose tissue. The insulin then causes these cells to internalize glucose, maintaining a normal blood sugar level. However, individuals with insulin resistance, typically those with visceral adiposity, are unable to process glucose in this way. Rather, normal levels of insulin do not trigger tissues to internalize glucose which causes the pancreas to release more insulin in the hopes of getting the cells to respond. At this point, blood sugar levels remain elevated. As a defense, the body attempts to dilute the sugar with water from cells, resulting in dehydration. Moreover, the hormone resistin is released by fat which results in more adipocytes becoming unable to absorb glucose from the blood causing overweight/ obese individuals to become more insulin resistant.

Adiponectin is another hormone released into the bloodstream exclusively by adipose tissue. It is considered to be an "insulin-sensitizing hormone" (Inukai, K., Nakashima, Y., Watanabe, M., Takata, N., Sawa, T., Kurihara, S. et al., 2004). The discovery of this hormone is relatively new; yet, early studies suggest that adiponectin is important in prevention of insulin resistance which is often associated with obesity. Obese individuals produce lower levels of adiponectin as visceral adiposity increases; therefore, these individuals are at increased risk of developing Type II Diabetes, atherosclerosis, and fatty liver disease.

The hormone leptin plays an important role in regulating body weight by modulating energy expenditure. In animal models of obesity, research suggests it is responsible for decreasing appetite by inhibiting food intake and increasing metabolism ("Leptin; LEP," 1966-2007). Metabolism can be described here as continuous chemical processes inside cells that convert fuel from food into useable energy for the body. Basically, leptin is secreted by adipocytes as a defense mechanism against starvation. As adipocytes become larger due to the accumulation of triglycerides, they produce more

leptin (Bowen, 1998). So, leptin levels increase as an individual's fat mass expands. In obese individuals leptin levels are high which should decrease appetite and increase energy expenditure. Yet, during weight loss, leptin reduces the number of calories burned by the body to keep an individual from becoming malnourished. Secretion of the hormone leptin decreases as adipose cells become smaller, as when weight loss is occurring. To keep a person from "starving," appetite will increase and resting energy levels drop. This hormone is at least partly responsible for making weight loss a difficult and challenging task.

Research Suggests: Genetic Linkage

A study conducted by C. Ronald Kahn, president and director of the Joslin Diabetes Center, and associates focused on identifying the distribution of visceral and subcutaneous fat (Gesta, S., Bluher, M., Yamamoto, Y., Norris, A., Berndt, J., Kralisch, S., et al., 2006b). He and his team of scientists extracted samples of subcutaneous and visceral adipocytes and pre-adipocytes from mice. Using a molecular technique called "gene chips," he was able to identify the genes in the fat cells (Gosnell, 2007). Of approximately 6,000 different mouse genes, the expression of an estimated 200 varied between the subcutaneous and visceral fat depots. Seven of these genes studied had higher levels of expression in the intra-abdominal (visceral) adipocytes, while five had high levels of expression in the subcutaneous cells (Gesta, 2006b).

In an effort to determine whether a similar pattern occurred in humans, Kahn sought another science researcher to conduct a test using human genes. Matthias Bluher, of the University of Leipzig, examined 10 similar genes in samples of the two types of fat taken from 198 human subjects (one-third of who were normal weight, one-third of who were classified as overweight and one-third of who were said to be obese). Bluher concluded that there were differences in the levels of gene expression between visceral and subcutaneous fat depots. Based on the genetic information gained, researchers were able to predict BMI and whether the fat was located in the abdomen (visceral) or on the hips (subcutaneous) for the subjects in the study. According to Stephanie Gesta (2006a), researchers are still unclear about whether this genetic information is a cause or an effect of obesity. Moreover, Kahn has been quoted saying "It is pretty clear that both obesity and body shape are to a large extent genetically programmed" (Gosnell 2007).

Two types of Fat: Subcutaneous Fat

The largest adipose tissue depot in humans is found in the subcutaneous layer under the skin. It contains large blood vessels, nerves and clusters of fat cells. The adipocytes in this context store lipids (triglycerides). Subcutaneous adipose tissue is most importantly a heat insulator for the body. The amount of insulation it provides depends on the depth of this layer, which is used by the body to regulate its internal temperature through a process called homeostasis.

The subcutaneous layer of the skin is attached to muscles and bones by connective tissue. In an individual with normal weight, the attachment is typically unrestricting. However, when the adipose cells increase in size, space becomes limited and the attachment between connective tissue tightens. This results in the "dimpling" or cellulite appearance on the outer layers of the skin. This is the most visible form of fat on the human body. Yet, subcutaneous adipose tissue deposits differently for men and women. In a very general sense, men typically take on the "apple" appearance such that their fat content is displayed in their mid-sections or abdomen, a pattern known as android obesity. In current research studies, men with these types of fat deposits demonstrate higher blood pressure and increased risk of heart disease, which is being linked with visceral adiposity. One study conducted on Japanese-American men found that testosterone levels were inversely related to high levels of intra-abdominal fat. Measurements such as total body fat (TF), intra-abdominal fat (IAF), body mass index (BMI), and testosterone levels, were taken at the beginning of the study. After seven years, researchers found that the IAF content of men with low baseline testosterone levels had increased to a mean of 8.0 cm^2. In this study, they correlated a change in IAF with low levels of testosterone but found no significant correlations to a change in TF, BMI, or subcutaneous fat. As a result, researchers suggest that low testosterone levels in males may contribute to health risks associated with visceral adiposity such as Type II Diabetes and cardiovascular disease (Tsai, E., Boyko, E., Leonetti, D., & Fujimoto, W., 2000).

On the other hand, women typically deposit subcutaneous fat around the lower body- thighs, hips, buttocks. Thus, this demonstrates gynoid obesity or the "pear" shaped appearance. Although, subcutaneous fat is the most visible in the body, it is not entirely negative in its effects. In fact, Osama Hamdy, director of the obesity clinic as Joslin

Diabetic Center, believes that subcutaneous fat is benign in its effects on health risks and is actually "good fat" (Gosnell 2007).

Two Types of Fat: Visceral Fat

As mentioned previously, adipose tissue is considered to be an active complex endocrine organ and visceral fat is more active than subcutaneous fat. Visceral fat is able to breakdown fats stored from the food individuals consumed earlier by releasing fatty acids into the bloodstream (Gosnell 2007). These processes are nearly continuous in order for energy intake from food and energy expenditure to remain constant throughout the body. Visceral fat is located in the abdominal cavity which surrounds vital organs.

Some studies indicate that as fat intake, such as saturated fats, increases through dietary consumption, so does visceral obesity. However, fat intake is not the only cause of high visceral fat levels. It is also being correlated with positive energy balance that occurs when more calories are eaten than are released from daily activity. Moreover, this type of fat is associated with insulin resistance (Type II Diabetes), cardiovascular disease [CVD] and other metabolic syndromes such as: liver damage, clogged arteries, high LDL cholesterol, high triglycerides, etc.

Visceral obesity has become a major concern among health professionals. It is not easily detected on individuals using the relatively inexpensive BMI method. Rather, it is estimated through magnetic resonance imaging [MRI], which uses magnetic waves to illustrate images of the approximate fat content hidden within the abdominal cavity. Another way to estimate the percentage of this type of central adiposity is to measure waist circumference [WC] or to calculate a waist-hip ratio [WHR]. These are useful in approximating the proportionality of fat distribution around the abdomen. To an extent, health professionals are able to use this information to identify risks of heart disease and diabetes in an individual.

Inflammation

As adipose cells continually change, the secretion of the hormones leptin, resistin, and adiponectin also are modified as the number of fat cells increases, which results in an increase of pro-inflammatory markers in the body. Researchers have been able to link obesity with increased levels of pro-inflammatory markers which originate in adipose tissue, such as cytokines and C-reactive protein. CRP is thought to be an indicator of

cardio-vascular disease [CVD] but is also higher in obesity (Stienstra, R., Mandard, S., Patsouris, D., Maass, C., Kersten, S., & Mueller, M., 2007).

As fat cells increase in size, they can become filled with macrophages. Macrophages are parts of the body's immune system and attempt to rid the body of infection. In obesity, macrophages secrete interleukins, or toxins, into the body. As a result, these toxins can cause damage to the liver and arteries as well as play a role in contributing to insulin resistance and ultimately Type II Diabetes. Yet, it remains unclear how the infiltration of macrophages directly affects white adipose tissue to result in insulin resistance and other health problems. Stienstra et al. (2007) believes that the modified hormone secretions may have an impact on the processes. Furthermore, scientists are beginning to view obesity as a state of low-chronic inflammation.

Factors that Contribute to Obesity

There are many factors which contribute to obesity. The CDC (2007b) suggests multiple contributing factors to obesity such as, energy imbalance, genetics, environment, behavior, socioeconomic status, and culture. Energy imbalance may perhaps be the most scientifically logical explanation for obesity. In regards to weight gain, energy imbalance refers to the amount of energy that is consumed by an individual is greater than the amount of energy being expended. In other words, overweight/ obese individuals are eating more calories than they are burning in specific time period. Although this is a reasonable rationalization, energy imbalance is not the only factor linked to obesity.

Scientists are on the cutting edge of relating genetics to obesity. Studies have been conducted in order to identify specific genes in the human genome that are responsible for fat deposition. Although still inconclusive, these studies indicate there is a direct correlation between genes and obesity. Some scientists suggest that there are certain genes which predispose the deposition of either visceral or subcutaneous fat. Hence, this is an area that is currently being investigated in order to learn more about how to manage and prevent obesity.

Environmental, behavioral, and social factors all influence the predisposition for excessive weight gain. Environments can be classified as the places in which people live and work. An example of a causal factor of obesity might include living long distances from work and driving or using alternative transportation, all the while remaining

sedentary during the commute and limiting overall energy expenditure. As technology continuously advances, more and more individuals perform daily tasks sitting down (i.e.: computers) which also contributes to less energy burned. Behavioral aspects coincide with environments and energy imbalance. For instance, some individuals may be less likely to engage in physical activity such as leisurely walks if they live or work in environments with high crime or no safe places to walk on such as a lack of sidewalks. In addition, making choices to eat fast foods for convenience or because of limited alternative options or eating larger portions to satisfy hunger can be attributed to behavioral decisions that are related to the environment.

Socioeconomic status may also contribute to obesity. Foods high in saturated fats, which tend have high caloric percentages, are relatively inexpensive. Some studies suggest that those individuals with low income levels may be at a disadvantage when purchasing higher cost nutrient-rich foods such as fresh fruits and vegetables. As well, limited education about nutrition may have an affect on the potential to gain weight. In addition, the costs of gym memberships may deter more poverty stricken people from joining physical activity clubs.

Since obesity has been on the rise for the past several years, scientists are still conducting research in other areas which include trying to link certain cultures to having a predisposition for becoming obese. As well, they are investigating how lack of sleep affects individuals and their weight and how the use of medications, such as steroids or antidepressants plays a role in weight gain.

Conclusion

This report has defined obesity and its correlation to body fat content by specifically outlining the two main types of body fat: visceral, intra-abdominal fat, and subcutaneous fat, underlying the skin. When learning about these two main types of fat it was important to assess the risks associated with each. Some of the most common risks linked to obesity are associated to visceral fat tissue and include insulin resistance, Type II Diabetes, cardiovascular disease, fatty liver, atherosclerosis, and high cholesterol.

In addition, it discussed the hormones secreted by adipose tissue in the human body. The three main hormones produced by adipose tissue are leptin, resistin, and adiponectin. Leptin is an appetite suppressant and is produced by the body to regulate

body weight by modulating energy expenditure. Resistin enables cells to become less sensitive to the action of insulin. Adiponectin is an insulin-sensitizing hormone.

In conclusion, the information set forth in the above paragraphs is continually changing as new studies are being conducted to discover the most current information. Much of what we know about obesity and the adiposity associated with it are relatively new and under investigation. As obesity trends continue to increase in America, the race is on to educate individuals about the health risks associated with adiposity. Education is important in helping scientists and health professionals "move" such a sedentary society to live a healthy lifestyle.

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Title: ***Fat… It's not all that! Learning How to Live a Healthy Lifestyle!***

Stage 1: Unit Description:

This unit is planned to allow students in middle school to gain a better understanding of what is means to be healthy and how to live a healthy lifestyle. The Backwards Design approach is used throughout this unit and can be divided into three parts: identifying desired results of the overall unit, determining acceptable evidence to assess student understanding, and planning learning experiences and instruction that integrates the inquiry based approach.

Throughout this unit, students will investigate the effects of obesity, the relationship between diet and exercise, and nutrition. Additionally, students will learn that there are different types of fat and how they affect overall health. They will explore how to calculate caloric intake, BMI, and energy expenditure. Additionally, they will learn the difference between fat soluble and water soluble vitamins and the nutrients that they provide for the body. As well, students will study about how the food industry makes unhealthier foods more appealing to younger generations. Through inquiry, the students will be able to understand what is needed to be considered healthy. They will be able to design and implement a health/ fitness plan for themselves based on their own personal goals.

Overall, students will gain a core understanding of health from a nutritional aspect. They will be able to use this information to educate and inform others on how to live a healthy lifestyle that incorporates eating the right types of foods and exercising daily.

Unit Enduring Understandings:

1. Food is a source of nutrients and energy for the body which is used to help bodies grow and develop.
2. There are different types of fats, some of which are good for the body and some which are bad.
3. There is a direct relationship between poor diet and lack of exercise to overweight/ obese children.
4. Obesity is a leading cause of health problems such as, type II diabetes, atherosclerosis, and fatty liver disease, in the United States.
5. Regular exercise is important in maintaining a healthy lifestyle and improving overall health.

Unit Essential Questions:

1. Why do food companies put nutritional information on the packaging of their products? How do I read a food label and what information can we get from them?
2. How does the body get energy from the foods we eat? Which foods provide the best sources of energy?
3. Why does exercising improve health? How much exercise should I get everyday?
4. Why do people gain weight? How much is too much?
5. How does obesity relate to Type II diabetes and cardiovascular disease?
6. How can I live a healthy lifestyle?

What students will need to know and be able to do (knowledge and skills):

At the end of this unit, students will:

1. understand the effects of poor health habits, specifically overeating and lack of exercise.
2. describe and identify the risks associated with poor health habits.
3. read and comprehend a nutritional label.
4. know the benefits associated with eating nutritious foods and daily exercise.
5. design and implement their own healthy living plan in accordance with their basic needs.

What do students typically misunderstand?

Based on recent studies, researchers have found some common misconceptions associated with health and fitness. One example of this is that some people commonly think that thin, or underweight, individuals are healthier than fat people (Healthy Eating Club, 2005). This perception is based on physical characteristics rather than on the biological processes associated with fat deposits and the risks related to poor diet. This notion demonstrates a misunderstanding about metabolism and how different types of foods are processed by the body. For instance, a thin person could have a high metabolic rate to keep them slender; yet, the foods that they eat could be high in cholesterol or saturated fats, which have recently been linked to some biological diseases. Therefore, "thin" does not necessarily mean "healthy." This misconception challenges students to re-examine the meaning of being "healthy."

Other preconceived notions that students may have deal with food intake, such as the ideas that you can't get fat if you don't eat fat (Johnson, n.d.). Here, people commonly misunderstand the concepts behind types of fats and portion control. Fat is needed in a person's daily diet; yet, people have difficulty distinguishing good fats from bad fats and the amount which should be eaten to remain healthy. Understanding the differences between saturated and unsaturated fats can be a difficult task when deciding what to eat. As well, many individuals can not distinguish which foods contain specific types of fats. Therefore, reading food labels becomes the next confusing endeavor when trying to distinguish between types of fats and the amount contained in each serving. As a result, misconceptions may develop like "if it's labeled 'fat-free,' you can eat larger portions" (Osgoodby, 2007). This is simply untrue due to the fact that there are other ingredients in foods that contribute to caloric intake and fat deposition. The need to learn about nutrition gained from food becomes evident here. In addition, portion control becomes a major component in learning how to eat a "balanced" diet. This means that individuals should be eating greater amounts of foods high in nutritional benefits, such as fruits and vegetables, and a decreased amount of foods high in saturated fats, like processed meals. Moreover, learning about the nutritional components in foods can lead to maintaining a balanced diet with appropriate serving sizes.

Other misconceptions arise when examining a persons' energy expenditure. For instance, confusion sets in as individuals believe that the only way to burn fat is to "live in the gym" or your muscles will "turn to fat" if exercising ceases (Gale Group, 2000). With these types of misconceptions, individuals are unaware of the various ways to burn excess calories. Exercise can be any physical activity which increases the amount of heat

energy needed to equal the amount of heat required to raise the temperature of water one degree centigrade at one atmosphere pressure. In other words, exercise is activity which burns a calorie. Weight loss results when the amount of energy expended exceeds the amount of calories taken in the body. So, physical activities which allow this to happen within the body can be considered exercise. Some various forms of exercise are listed as: walking, jogging, bicycling, swimming, dancing, etc. These activities can all be done outside of a gym or fitness center which disproves the idea that the only way to burn fat or lose weight occurs within a gym.

Also, some students are unable to distinguish between muscle cells and fat cells in the body. Biologically this notion is incorrect due to the structure and function of these two types of cells. Muscle cells compose muscles in the body which are used for movement (skeletal), blood circulation (cardiac), or digestion (smooth). On the other hand, fat cells store fat in the form of triglycerides. Fat provides a source of energy to the body, which protects, cushions, and insulates vital organs. Therefore, if an individual does not "exercise" muscle cells can not turn into fat. Rather, fat deposits may increase as a result of the decrease in energy expenditure causing an illusion of change from muscle to fat.

Another preconceived notion about health and fitness originates in the so-called "disappearance" of fat cells. Research reports that some people believe that fat cells dissolve once weight is lost. Yet, they do not realize that fat cells do not disappear, rather they only shrink. In fact, the only way to rid the body of an actual fat cell is to remove them surgically (i.e.: lipo-suction). Fat cells get larger when fat is increased, yet when they reach maximum capacity they will divide to create new fat cells. These cells will remain in the body, but they may fluctuate in size dependant upon the balance between caloric intake and energy expenditure.

Overall, preconceived notions about one's own health and fitness can become easily misconstrued. Misconceptions can be categorized by food intake, energy expenditure, and portion control. This unit is designed to address some of these common misconceptions so as to help students gain a deeper understanding of what it means to live a healthy lifestyle. They will be addressed by implementing pre-assessment questions, which will allow the teacher to detect common misconceptions in the area of health and fitness.

National Science Education and Pennsylvania State Standards:

The context for the content addressed in this unit can be found in the *National Science Education Standards* [*NSES*] related to *Personal and Social Perspectives*. These standards focus on helping students to develop decision-making skills which impact their own lives as well as the lives of others. Broadly, it is expected that students in grades 5-8 will develop an understanding of aspects of personal health. *Content Standard* F addresses personal health, populations, resources and environments, natural hazards, risks and benefits, and science and technology in society. For the purpose of this unit plan, the content standards related to personal health will be the focus.

For students at the middle level, studying the impact of science-related issues on individuals and society takes on a very personal meaning. At this developmental stage, students become more aware of their bodies and of their physical health (rather than their mental health, which takes on greater meaning a bit later in life). They are ready to learn,

for example, that illness can be caused by (among other things) bad health habits. Also, at this level, students have knowledge of health associated vocabulary but generally lack a scientific understanding of these terms. Thus, the standards focus on aiding students' comprehension of these terms and definitions as they apply to real life. As well, healthy behaviors and other aspects of health education are emphasized during middle school years so as to gain a deeper understanding of the scientific concepts that underlie health and fitness.

The fundamental principles of personal health and risks/ benefits that underlie this standard for 5th through 8th grades and that **directly** relate to this unit plan are further described in the NSES (1996) as:

- Regular exercise is important to the maintenance and improvement of health. The benefits of physical fitness include maintaining healthy weight, having energy and strength for routine activities, good muscle tone, bone strength, strong heart/lung systems, and improved mental health. Personal exercise, especially developing cardiovascular endurance, is the foundation of physical fitness.
- Food provides energy and nutrients for growth and development. Nutrition requirements vary with body weight, age, sex, activity, and body functioning.
- Students should understand the risks associated with personal hazards (including dieting).
- Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits.
- Important personal and social decisions are made based on perceptions of benefits and risks.

Stage 2: Determine Acceptable Evidence

Title: Healthy School… Healthy Kids!

Goal: *What is the goal of the performance?*
The goal of this performance activity is for students to create a healthier school environment by evaluating school menus, implementing daily exercise routines, administering education stations on nutrition and fitness, and creating brochures, posters, and assemblies on the importance of living a healthy lifestyle.

Role: *What role does the student assume in the performance?*
Students will assume roles as leaders whose job is to get others in the school community to understand the importance of health and fitness.

Audience: *What audience does the student address?*
The audience is the board of trustees of the school, administrators, teachers, food services staff, and other students.

Situation: *What is the situation for the performance?*
The participants were handpicked by the science coordinator at their school to be student leaders. In small groups, they are to design a series of events focused on educating their audience about the effects of obesity, the nutritional content of cafeteria foods, the differences between types of fats, how to lose weight through healthy diet and exercise, the right types of exercise, and outline specific foods that supply the body with necessary amounts of energy.

Product: *What should be produced?*
The presentation will be in the form of informational pamphlets, awareness posters, active discussions with the audience, in-class demonstrations, and health and physical education lessons taught by the group.

Standards: *What are the standards for the product?*
In regards to scientific information:

1. Clearly defines scientific terms and principles used for explanation of concepts.
2. Accurately incorporates scientific and mathematical calculations and formulas (i.e.: BMI).
3. Demonstrates a core understanding of the scientific principles about personal health and fitness based on student abilities to apply concepts to their own lives.
4. Demonstrates measuring BMI and calculates target heart rates with accuracy.

In regards to the presentations (i.e.: brochures, discussions, etc.) themselves:

1. Presents information in a clear and logical manner.
2. Exudes confidence and makes eye contact with audience.
3. Demonstrates appropriate knowledge of information and makes connections to scientific principles set forth in the unit.

4. Commands a decent knowledge of technology and use of PowerPoint (during lessons).
5. Actively engages audience in the presentation.
6. Prepared with handouts of findings on obesity, nutritional food labels, and high energy workouts for the audience.
7. All information is spelled correctly and commands an accurate use of grammar and mechanics.
8. Posters, brochures, and slides are colorful and engaging.
9. Utilizes allotted time wisely.

Preconceptions Assessment: Prior to starting the instructional units, students will be given the following prompts and questions to answer in writing:

1. Draw the body of an average American. Are they in shape? Overweight?
2. Do you have to be thin to be considered healthy?
3. How do people gain weight? How do they lose it?
4. Does exercise matter? Why do people exercise?
5. How much food should you eat at a meal?
6. Does the label "fat-free" mean it's good for you?
7. Which foods give us energy?
8. Why is it important to take vitamins?

Quizzes, Tests, and Academic Prompts:

- Preconceptions Assessment (This will give insight into what the students already know and how they perceive the topic.)
- Food and Nutrition quizzes (Students will be assessed on their knowledge of the food pyramid, the difference between types of fats, and their ability to read a food label).
- Self-Assessments (Students will keep a health journal on their progress towards living a healthy lifestyle).

Other Evidence of student learning:

- Lab Reports
- Charts and Graphs (i.e.: calorie intake, minutes of exercise, etc.)
- Performance-based assessments, observations

Stage 3: Plan Learning Experiences, Instruction, and Resources

Where they are headed and why?

- Preconceptions Assessment
- Introduce and discuss plans for the Unit
- Ask and post essential questions

Lesson 1

- **H**ook students through engaging and thought-provoking experiences
    - Average American: Students will complete Preconceptions question #1 and draw an average American male or female. Students will compare drawings within their small groups and then share out as whole class. At this point, the class will discuss the various viewpoints and collaborate to define overweight and obese. (EU#4)
        - This activity will provide for opportunities to detect misconceptions previously mentioned.
    - "What am I doing to be healthy?" Students will partake in this warm-up activity by standing up when they agree with a statement read aloud about their own personal health habits.
- **E**xperience
    - "Veggie Pie:" In this activity, students will identify as many vegetables as they can think of and poll each other to find out who eats these kinds of foods on a daily/ weekly/ rarely basis. They will then record the data and create a pie chart to show how many students eat different types of vegetables each week. On the charts, students should calculate the percentage of students who eat those vegetables. (EU#1)
    - In small groups, students will research information from government websites about the nutritional benefits of eating greens/ vegetables. They will report out on the recommended serving sizes and why they are important to our overall health. (EU#1)
    - Discussion: Students will talk about different ways in which vegetables are served and eaten. They will also learn the concept of "the more the merrier" when filling up their plates with greens/ vegetables. (EU#1)
        - Demonstration: Show 250 calories of vegetables compared to 250 calories of cookies.
- **R**eflect
    - Students will brainstorm ways to incorporate vegetables into their favorite dishes and favorite meals.

Lesson 2

- **H**ook students through engaging and thought-provoking experiences
    - "Vitam-in or Vitam-out?" Students will examine various vitamins and brainstorm certain aspects about them. They should come up with ideas about what they do for the body, how they work, and why individuals need to take vitamins. (EU#1)
- **E**xperience

  - Students will identify the two main groups of vitamins: fat soluble (A, D, E, and K) and the water-soluble (B complex). Students will be divided into pairs and each team will be given a specific vitamin to explore. They will research which foods contain the vitamin, the vitamins purpose in the body, how it functions, and how much is need to be considered healthy. Students will create fact cards about their vitamin and present their findings to the class. (EU#1)
  - Accommodations: Students with individualized learning goals will be paired with peer tutors.
- **R**eflect
  - Students will analyze their food logs and seek ways to incorporate more greens/ vegetables into their daily diets and find ways to cut out saturated fats. They will also investigate the types of vitamins that their diets lack and how they can integrate them in.

Lesson 3

- **H**ook students through engaging and thought-provoking experiences
  - "Too Sweet or not to Sweet: That is the Question!" In this warm-up, students will be asked what their favorite foods are and then asked to discuss the similarities amongst them. After several moments, students should be able to make connections to the ingredients. Most often, the foods kids like to eat contain sugar. Teacher will demonstrate how much sugar the typical American consumes in week using 2-3 pound bags of sugar. (EU #1 and #2)
- **E**xperience
  - Physiology of Digestion: Discuss and investigate the digestive system and the processes involved in obtaining nutrients and the conversion into energy from food.
  - Food Pyramid: Students will identify the recommended servings for the main food groups. They will also discuss the different types of nutrients in each group, specifically the difference between good fats and bad fats. They will then test their knowledge by interactively engaging in food pyramid activity at http://www.mypyramid.gov/kids/kids_game.html#. (EU#1,2)
  - Portion Size: In an effort to determine why 66% of Americans are overweight, students will actively examine various food items brought into school. They will compare the serving size recommended on the packaging label to the amount they would "normally" eat/ put on their plate. Students can then calculate their calories based on their "normal" portions. They will then work in groups to relate everyday items to the recommended serving sizes. (EU#1,2,4)
    - Modified versions: Students with learning disabilities may find calculating the number of calories challenging. They would be able to use calculators and other educational resources for assistance with this activity.

- **R**eflect
    - Draw a typical plate of food served in a restaurant. Draw the suggested plate of the same food. Compare the drawings.

Lesson 4

- **H**ook students through engaging and thought-provoking experiences
    - Fast Food: Students will be provided with different menus from various fast food restaurants. The names of the restaurants will be blocked. Students will work for only a couple of minutes to determine the names of the restaurants. When groups finish, students will share out their answers. (EU#2)
- **E**xperience
    - Students will research some of the risks associated with obesity. Each pair of students will look up information on a specific metabolic syndrome and report their findings to the class using PowerPoint presentations. (EU#3,4)
- **R**eflect
    - What factors contribute to large number of Americans who are overweight?

Lesson 5

- **H**ook students through engaging and thought-provoking experiences
    - "Slogans!" Students will brainstorm as many commercials as they can. As a whole group, the class will create a T-chart to compare the number of healthy food (low caloric/ nutritious) slogans remembered to the number of unhealthy food (high fat/ high sugar/ high caloric) slogans. (EU#1,2,4)
- **E**xperience
    - Appealing Ads: Students will work as teams of marketers analyzing foods, advertisements, and slogan centered on "kids or teen" foods. They will focus on determining how food distributors make their products appeal to younger generations and if they promise nutritional benefits and how that relates to actual nutrition. In addition, they will compare the advertisements and packaging of healthier snack foods to unhealthy snack foods. (EU#1,4)
- **R**eflect
    - Exit cards: How does advertising influence our decision to buy foods?

Lesson 6

- **H**ook students through engaging and thought-provoking experiences
    - Jumping Jacks: Students will make predictions about how their heart rate will respond to exercise. Once they have made predictions, students will do jumping jacks for 1 minute and take their pulse (count the number of times their heart beats within a certain amount of time). Students will record their heart rate and re-visit their initial predictions. They will share out the data as a class. (EU#3,5)
        - For enrichment, students could compare heart rates of athletes to non-athletes to demonstrate the benefits of exercise.

- **E**xperience
  - BMI: This activity focuses on teaching kids how to measure their body mass index. They will use mathematical formulas and graph voluntary class data. (EU#4,5)
    - Modified versions: Students with individualized educational goals should use online database resources for calculating BMI (http://apps.nccd.cdc.gov/dnpabmi/Calculator.aspx).
  - Students will participate in aerobic activities to learn first hand how to measure active pulse rates. They will investigate various exercises and compare pulse rates for each. They will record and graph their data. (EU#3,5)
    - Extension Activity: They may visit online sources and calculate the amount of calories burned during different activities (http://www.healthstatus.com/calculate/cbc).
- **R**eflect
  - How does the body respond to exercise? Make a list of activities you do regularly that can be considered exercise.

Lesson 7

- **H**ook students through engaging and thought-provoking experiences
  - Daily Log: In an effort to create awareness about spending time more productively, students will record how they spent their time yesterday from the moment of awakening to the moment they went to sleep. (EU#5)
- **E**xperience
  - Students will create their own fitness plans that coincide with their daily eating habits, and their BMI. Using this information, they will determine their target heart rate and design an activity plan that supports healthy habits. (EU#1,2,3,5)
- **R**eflect
  - Students will brainstorm 10 ways to increase their own daily activity level.

Lesson 8

- **H**ook students through engaging and thought-provoking experiences
  - Counting Calories: Students will partake in Math activities where they discuss weight loss/ gain as the surplus/ deficit of calories. They will investigate how many calories make a pound, how many cookies that converts into, and how many jumping jacks would they need to do to burn off the excess calories. (EU#3,5)
- **E**xperience
  - "Body Builders:" Students will keep a food/ activity log where they will record all of the food they ate and any pulse rate activity they engaged in for a week. (assigned 1 week before lesson is taught)
    - Students will record the number of calories taken in at each meal and total at close of each day.
    - Create charts and graphs of individual, group, and class data.
- **R**eflect
  - After knowing the number of calories you intake in a week, how does that make you feel? Do you believe you are healthy?

Lesson 9

- **H**ook students through engaging and thought-provoking experiences
  - Design a series of questions to ask others about their health habits.
- **E**xperience
  - Survey others in school community about their daily eating/ exercise habits. Students should gather information about misconceptions people have about living healthy lifestyles. (This will precede the culminating unit project). (EU#4)
- **R**eflect
  - Students will write a reflection about the information they have learned throughout this unit and how it has/ will affect their life. What do they think they will continue to focus on?

Exhibit their understanding *throughout* the lessons:

- Students will re-visit the preconceptions assessment questions after the unit and compare their responses.
- Students will be assessed on the culminating unit project: "Healthy School… Healthy Kids!" (**Lesson 10**)
- Self-assessments of their own health/ fitness habits.

Activities in this unit were adapted from:

Do Something about...Eating Healthy 10-Day Unit (1996-2007). Retrieved on August 3, 2007 from, Do Something, Inc.: http://www.lessonplanspage.com/PEODoSomethingAboutHealthyEatingUnitDay1GreenScene912.htm

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