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What Is Going On Inside My Body? An Introduction to the Central Nervous System and the Digestive System

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Introduction

Our bodies serve as amazing creations that hold much mystery for even the most educated among us. When you consider the perspective of a child where the human body is concerned it is fascinating to watch them discover how their bodies function. Children are often unaware of the nutrients needed to sustain a healthy and active life, and most do not see the correlation of their schoolyard games, cafeteria lunches, and P.E. time as relevant to their bodies. I believe that it is important for children to discover exactly how their bodies work and learn about the foods that will support the bodies systems. Providing them with this information will lay the foundation for future learning, empower them to make better food choices and answer the age old question, "Why do I have to eat my vegetables?"

Rationale

Over the past six years, I have observed many of my students bringing snacks to school that they perceive as being healthy. Instead of bringing in snacks with a high nutrient content such as vegetables and fresh fruits, students would snack on gummy snacks and hot chips, all while attempting to convince me that these items must be nutritious because package ingredients list items such as corn or fruit. For my students this has become an indication that their snacks must be healthy in light of this fact. On any given school day, I find myself having to motivate my students beyond class work, due to their energy levels and often-lethargic nature. This impedes not only their ability to experience an optimal educational encounter, but also hinders my ability to instruct.

Fully convinced that their food choices were the leading cause, I attempted my own informal experiment by eating school lunch for one year. After lunch, I experienced feelings ranging from satisfaction to disgust, illness, hunger and anger. If I was feeling this way, I could only imagine what my students were going through. I also observed the foods student would select. Most students would go for the processed "mystery" meat and packaged carbohydrates skipping past fresh fruit or packaged vegetables when offered. Sadly, on too many

occasions students and I chose nothing from the foods offered, as it was simply disgusting. It was clear to me that changes needed to be made if our afternoons were to be productive.

As an alternative to the norm within the classroom, I quickly looked for the areas where we could make sustainable changes during snack time. I wanted this process to be not only about my students, but also about my own health and wellness. I started with a daily routine of snacks that would produce higher energy levels, healthier approaches to eating, and also that would be as accessible as any prepackaged snack. One of the steps that I took was to institute "Ms. Lewis Law". All snacks had to be healthy, any junk food brought to the classroom would be immediately confiscated, and there needed to be an understanding of why they needed to eat this way during snack time. In the beginning a few students and parents resisted, arguing that, after all, it was only a snack or that prepackaged foods saved time and were cheaper to buy. After some wrangling, a few parent encounters, and some time everyone began to see the value in "Ms. Lewis Law".

Educating children and their parents was the only way to make a true change. Our school now has a school garden, but the program is susceptible to closure every year due to funding. So the intention behind creating healthy alternatives is to provide my students with eating habits that can translate into their home life as well. I would like my students to know the why behind my strict snack rules in the hope that they will see the benefits to their overall health. This is reason I created this unit. The broader issues associated with my student's health need to be addressed and it is often difficult for a teacher to make this an interactive learning experience.

Objectives

The unit "What's Going On Inside My Body?" is designed for second and third grade classes. This unit will focus on how the human body works, and explore what actions can be taken to support a healthy life. Specific emphasis will be placed on how the human body functions. The digestive and nervous systems will be covered in addition to nutritional guidelines.

This unit has four main goals. First, it will introduce students to basic functions in the body and the organs associated with these functions. Second, it will look at the nutrients and minerals needed to maintain a healthy body. Third, it will equip students with tools that empower them to make healthy choices and develop healthy habits. These habits will inevitably produce life long benefits. Finally, the unit will address the current 2 nd and 3 rd grade California State Health Standards and Common Core State Standards.

Background

There are the 11 systems that make up the human body: skeletal (bones), muscular (muscles), nervous (nerves), integumentary (hair, skin and nail), lymphatic and immune (hormones and white blood cells), endocrine (hormones), cardiovascular (blood), respiratory (oxygen), digestive (nutrients), urinary (waste), and reproductive (babies) systems. These systems work cooperatively while fulfilling their own vital functions in an effort to maintain health [1] . While all of these systems work together, one can be viewed as the conductor of

sorts. This is the nervous system.

Nervous System - "The Fact, Just the Facts"

Research on how the body functions shows that the human body is made up of millions of small structures that perform a huge number of different tasks. These actions are organized and integrated into a smooth harmonious system. [2] The two main communication systems in the human body are the nervous system and the endocrine systems. These systems send messages and impulses to all of the structures in the body. In other words, when the body is working optimally the brain knows what is happening in all regions of the body, even when we are unaware. First, we will look at the nervous system.

The nervous system is made up of three parts, the central nervous system, peripheral nervous system and autonomic nervous systems. Each system plays a key role in how communication is orchestrated in the body. The function of the central nervous system (CNS) is to communicate and coordinate the other systems in the body, meaning this is the system responsible for receiving messages, interpreting them, responding and carrying out the corresponding action. Its second function is to provide a safe site that will house our intellect, the ability to reason and understand. The brain and spinal cord make up the CNS. [3] This complex, highly organized system uses special cells in the body to perform this task, nerve cells.

Nerves

Nerve cells or neurons are the agents that carry out the function of transmitting messages from one to another [45] . The brain alone has over 100 billion nerve cells and the body contains many more. Similar to all other cells in the body, the neuron has a cell body with a nucleus that sits inside of it toward the middle. However, nerve cells are different in that they have extensions or processes called dendrites and axons. On any nerve cell there may be several different dendrites, but there is only one axon. These dendrites tend to be shorter in length and branch out in many directions, gathering information. Axons on the other hand are usually longer with fewer branches. Along the line of some axons fatty wrappings called myelin sheaths are found. They look like beads on a chain of a necklace. This special covering insulates the axon to prevent it from short-circuiting and it also speeds up transmission of the signal being delivered. Dendrites and axons form a pathway for communication. Each one has a specific job in this unique communication process. Dendrites receive messages from other cells and carry that message into the cell body [67] .

Neurons like all other cells in the body need provisions; therefore, supporting cells called glial cells protect and nourish the neurons. These "protectors" guard the environment of the neurons by destroying foreign particles and clear away cell debris from cut off fibers. They are sometimes called the "nerve glue". Neurons and glial together create nervous tissue. These structures are vital to ensuring the message gets to its destination.

Information travels through the body by way of tiny electrical currents called nerve impulses or actions potentials. The current is created when sodium, which is rich in the (extracellular) fluid outside of the neuron, passes across the membrane of the cell, creating an electrical change. With delicate precision, potassium, which is rich in the fluid inside the membrane (intracellular fluid) of the neuron, also passes across the membrane in an effort to recover the normal electrical state. This action happens again and again through the neuron until it reaches the end of the neuron. The rate at which these impulses complete the entire process is faster than a blinking eye (300 - 400 milliseconds), a few milliseconds. Electrical waves like this happen all day long, all throughout the body, millions of times for an entire lifetime [8] .

Next up is the big "jump" across the synapse. When an electrical process reaches the end of the axon it changes into a chemical form to jump across to the next dendrite to continue the message through the body. The reason it needs to make a jump is due to how dendrites and axons communicate. While they are connected, they never actually touch. The space between the axon and receiving dendrite is called the synaptic cleft. This gap fills with a liquid as molecules (neurotransmitters) glide across this extremely small space to pass on the impulse.

Brain - Three pounds of power!

The human brain is a soft tissue organ colored white and gray that works closely with the spinal cord to manage processes in the body. Some of these processes we are conscious of, yet others we are not [9] . For example, you do not have to think about making your heart beat or keeping track of its rhythm. Breathing is another function of the body the brain controls without a conscious effort on the part of the human in which it resides. The structure is unlike any other organ in the body.

The tissues of the brain have unique grooves due to the folding of the surface called the cerebral cortex[10] . This precious organ has three levels of protection. (1) The meninges are reported to be a tough, dense membrane of connective tissue that has a great quantity of blood vessels. It looks like a "cobweb" with fluid filling the spaces. The function of the meninges is to provide nutrients to the organ and act as a shock absorber. (2) Cerebrospinal fluid like meninges supplies nutrients to the brain, and absorbs shock waves from daily activities. Contained within a unique network of ventricles and linings it establishes a filtration system to remove and carry away waste products. The shock absorbing qualities are key, without them the brain organ would knock up against the skull bone repeatedly. This would give a new definition the term "headache". (3) Finally there is the bony cranial cavity call the skull. Simply put it is the bone's lightweight structure that houses brain matter. Inside of this protection is the brain, which has four parts the cerebrum, diencephalon, cerebellum and the brain stem. Each part has a special function and responsibility[11][12] .

Cerebrum

The largest section of the brain is the cerebrum. It takes up "more then four-fifths" of the entire tissue [13] . Deep folds in the surface tissue form four key sections in the cerebrum. The greatest of these sections is the frontal lobe, as it is located in the front of the actual brain. This lobe is responsible for speech production, beginning the movement process, and characteristics of personality are associated with this lobe. On the top back portion of the brain is the parietal lobe. All the body's sensory data is reported and synthesized here. An example would be sensations like pressure, pain and temperature. Moving toward the back of the brain is the occipital lobe. This area has important sensory function to sight. It is the processing point in the brain for the information collected in the eyes. Finally, on the sides of the brain is the temporal lobe. This region is responsible for recognizing sounds, tones and loudness. It also plays a role in storing memories [14] .

Diencephalon

Located between the cerebrum and the mid brain is the diencephalon. It is comprised of two main structures, the thalamus and the hypothalamus. The first sits on top of the brain stem and is shaped somewhat like an egg. This control center serves as a receptionist for the cerebrum by monitoring and processing incoming and outgoing nerve impulses. The later structure called the hypothalamus has been thought of as, "the brain" of the brain. It is the center where all parts are connected. The diencephalon performs but is not limited to the following vital functions: breathing, heart rate, temperature, appetite control, signals thirst, release of

oxytocin (hormone released that contracts the uterus & produces milk), digestion, display of feelings, sleep cycles and "mind-over-body" experiences[15][16] .

Cerebellum

The smallest section of the brain is structured some like the cerebrum. It is made up of gray matter on the outside and white matter on the inside. The cerebellum is responsible for the control of all body functions dealing with skeletal muscles. It controls the accuracy and timing of skilled movements such as balance, posture, coordination and muscle tone[17] .

Brain Stem

The brain stem is structured in three parts: the midbrain, pons and medulla. These centers regulate several vital survival functions in the body such as heartbeat, blood pressure, breathing, and reflex actions of swallowing and vomiting. It also provides a pathway for messages to flow to and from the cerebrum. It extends and connects with the second part of the CNS, the spinal cord[18] .

Spinal Cord

The spinal cord is an intricate collection of nerve fibers that extend 16 - 18 inches long. Starting at the base of the brain it extends to the lower part of the body. Its shape is like that of a flattened cylinder, and no wider than a pencil for the most part. As it extends down the spinal column it trails off into a threadlike tail at the base. There are 31 spinal nerves that branch out from the spine. These nerves connect to the skin, muscles, chest, abdomen and the limbs. They carry messages to the brain about the conditions in their perspective areas in the body. One special function of the spinal cord is that in some cases it can bypass the brain to give a motor response to certain sensed nerve impulses, in the form of a spinal reflex [19][20] .

Peripheral Nervous System - Let us make "sense" of it all.

The nerves in this system connect the brain and spinal cord with sensory receptors, muscles and glands in all parts of the body. There are 12 pairs of cranial nerves directly connected to the brain rather than the spinal cord, and 31 pairs of spinal nerves. Each of these nerves is connected to a specific segment along the spinal cord by two roots. The posterior roots give sensory information, while anterior roots give motor information. Medical research has revealed that specific branches are associated with specific organs in the body [21] .

Autonomic Nervous System - Checks and Balances

The autonomic nervous system (ANS) has the distinctive job of maintaining constant and consistent conditions in the body. The name for this function is homeostasis. The ANS accomplishes most of it work independent of the conscious mind, therefore we are hardly aware of it work. Some of the nerves in this system are shared with the CNS and PNS. It provides involuntary responses due to the task completed are generally "automatic", immediate and long term.

Here is quick snap shot of how it works. Sensory nerves send data about an organ and internal activities like the lungs and breathing. The data is integrated in to the hypothalamus, brainstem or spinal cord. It is the ANS that then send out the commands to the organ, as a motor nerve signal. The response command is given to all the key participants in the process of breathing within fractions of a millisecond [22] .

Digestive System - Give Me What I Need!

In order for the human body to survive, every small region in the body must have nutrients. As discussed before, nutrients are carried throughout the body by the circulatory system and cells of all types. The digestive system can be described as a long passage way distinctively designed to breakdown food substances into usable forms for the cells that support life. While this sounds like a simple process of eating, mixing and pushing out, the system is much more complex than that. Digestion begins at the mouth and ends at the anus [23] . By definition digestion is "The process of changing complex solid foods into simpler soluble forms which can be absorbed by the body cells [24] ." How exactly does this happen?

The entire gastrointestinal tract (GI) is an unbroken tube of about thirty feet in length. The structure is made up of the mouth, throat, esophagus, stomach, small intestine, large intestine, and the anus. Its job is to break down food into smaller parts, and extract useful nutrients such as fats, carbohydrates and proteins. It must also absorb the nutrients into the body for use and get rid of all unusable products. The process from start to finish is a voyage that can take up to one whole day (24 hours). Like other systems in the body it too has helpers to complete its process called glands. Glands produce juices that aid in different ways to get nutrients into the systems of the body [2526] .

Mouth and Throat

When food enters the mouth, four classes of teeth (incisors, canine, premolars and molars) work together to crush and grind foods. Once your "mouth full" or "bite size" amount of food is ground up it is now called a bolus. This bolus can be swallowed. Swallowing is an involuntary reflex where the muscles in the throat contract to push food (bolus) back and down to the esophagus (food pipe). Here another structure lends a simple but key role. The epiglottis is a flap of tissue that blocks the connection to the windpipe and guides food to toward the esophagus. This simple function keeps food from "going down the wrong way [27] ".

Stomach, Accessory Organs and Small Intestine

The esophagus carries the bolus into the next section along the digestive trail, the stomach. Normally, the stomach can hold 1.5 - 4.0 liters of food from a meal. The organ itself is muscular and shaped like the letter "J". Inside this sac, food is broken down physically and chemically. After food enters the stomach waves of contractions churn and mix the food with gastric juices containing digestive enzymes and hydrochloric acid. This breaks the food down and also kills harmful bacteria. In the process food becomes liquefied and small amounts, about a teaspoon full, gets spewed into the small intestine.

Final arrangements for nutrient to be absorbed into the body happen in the small intestine. The small intestine that coils in the abdominal section of the body can be as long as twenty feet. It is also divided into three sections (duodenum, ileum, jejunum). Chyme, a mixture of food and stomach acid, is ejected into the small intestine. As it travels along the three sections it receives digestive juice from some accessory organs, the liver, pancreas, and gallbladder [28] . These and other secretions break food down to its useable parts. Accessory organs are defined as organs that assist in the digestion of food but are not apart of the digestive tract. The tongue, saliva glands, pancreas, liver and gallbladder are a few examples [29] .

Absorption of nutrients takes place in the lining of the small intestine. The lining contains many tiny projections, called villi. This is the structure that takes the nourishment up into the blood stream for cells to use. The portions of chyme in the small intestine that remain unusable are passed on to the large intestine [30] .

Large Intestine -Last Stop!

The large intestine is the last stop before elimination from the body. The organ is about five feet long and about two inches in diameter. Chyme enters from the small intestine passing through a valve into a small pocket called the cecum. This valve is important as it stops back flow. Attached at the bottom is the appendix, which has no digestive function. The function of the large intestines is to take the remaining liquid chyme and translate it into semisolid feces for disposal. As the water is absorbed from the liquid like substance stool is formed [31] .

Cellulose is one of the substances found in stool. This fibrous part of plants is indigestible by humans. It makes up a great portion of the feces. This bulk of cellulose encourages the muscles to activate in the colon, producing defecation. Getting rid of unusable substances is good for the body. Scientists report that having a diet rich in foods that contain cellulose is desirable as it promotes digestive health. Foods rich in cellulose include fruit, vegetables, and whole-grain cereals [32] .

The rectum and anus are the exits from the body. The rectum is normally empty until just before an exiting movement. Just below the rectum is the anus canal, which has two of the strongest muscles in the body. As movement happens in the colon, the muscles relax allowing feces to exit.

Nutrients - The Good Stuff

All systems in the body need nutrients. So what exactly is a nutrient anyway? Nutrients, are substances found in food that humans need for their cells to function properly. Therefore, in order for foods to be considered nutritious they must contain one or more of these essential substances: water, carbohydrates, lipids (fats), proteins, minerals and vitamins. These substances can be used to support one or all systems in the body because they are involved in many processes.

Water is listed first because 55 - 65% of a humans total body weight comes from water. Everyday the body loses water through excretion, evaporation and respiration. This water must be replaced: therefore it is recommended that every one should drink eight 8 oz glasses per day. Exercising, sweating or vomiting increases the need for water. In fact, experts report that by the time a person recognizes they are thirsty, mild dehydration has already set in.

Carbohydrates in food function as the main energy source in the body. They are classified by their chemical make up into four groups. Smaller molecules of sugar are more easily absorbed into the body. When there is an excess of carbohydrates in the body they are converted into fats and stored in fat tissues [33] . It is recommended that 50% - 60 % of the daily intake of food should come from carbohydrates.

Ideally, the key is to get the most from the foods you eat by selecting options that give you the most nutrients. This helps the body to function well. In addition to providing energy, these foods also provide minerals, roughage (fiber), and vitamins. Roughage is the portion of foods that are indigestible. They are vital to maintaining a healthy digestive system. Fibers are credited with many health benefits such as fighting off constipation, and lowering the risk of cardiovascular disease by combining with cholesterol to prevent its over-absorption in the body. Foods that fit into this group are whole-grain breads, cereals, fruit, potatoes, vegetables, and brown rice.

Lipids are next on the list of essential nutrients needed in the body. These are compounds of fatty acids and alcohol, or simply "fats". Like carbohydrates, they also provide the body with an energy source. Lipids are

different in that they have twice as many calories as the same amount of protein or carbohydrates. Their stored location is inside of tissues for the purpose of an emergency, like sudden illness or starvation. Working in the body, lipids have the following functions: cushion internal organs, insulate against cold, make up a part of cell membranes, and contribute to the making of bile for digestion [34] . It is recommended that 25 -35% of lipids should be in your diet [35] .

A word on cholesterol is appropriate here. Cholesterol is a white, waxy like substance that is sold at room temperature. This substance can be found in two forms. Cholesterol can come from foods eaten such as meat or it can come from the liver. The liver produces cholesterol to build cells and make hormones. Now, there is "good" cholesterol that takes this fat away from the tissues in your body to the liver for processing. On the other hand there is also "bad" cholesterol, this type carries the waxy like substance to other tissues in the body. This can cause substantial problems once there is blockage. Foods that support the body getting rid of the "bad" cholesterol are garlic, fresh fruit, vegetables, prunes, and oat or wheat bran.

Proteins are another vital nutrient for the body. Proteins are broken down by the digestive system into amino acids. These amino acids can then be used by cells in the body to build proteins that are needed for body functions. Proteins function in the body as a regulator of chemical reactions, and provide tissue growth and repair. They too can be use as an energy source. All cells and organ systems in the body depend on the use of protein to function properly. Systems include but are not limited to the circulatory, muscular, endocrine, nervous, and immune all use proteins in one way or another.

There are two ways humans can attain the essential proteins need for life, by eating animal products or vegetables. There is a slight difference in the two sources. First, animal proteins like milk, eggs, and meat are considered "complete" proteins. They have all you need in one item. On the other hand should you choose to get protein from vegetables it must be done by mixing and matching, because vegetable are considered "incomplete" proteins. Eating one type alone is not sufficient to supply what the body needs. An example would be eating whole wheat bread alone. However, almond butter and whole wheat bread eaten together will get the job done. Finally, the human body cannot store extra amino acid. Instead, when excess is presents, the compound is further broken down by the liver, after which some portions are use as immediate energy or they are stored as fat.

The final two nutrients the body gains from food intake are minerals and vitamins. Four percent of the body is made up from minerals. Some like sodium, potassium, calcium, iron, phosphorus, and zinc are used to help in various functions. Their work in the body is directly related to growth and maintenance. For example, minerals help to form bone and teeth structures, maintain heart rhythm, and produce muscle contractions.

Vitamins are active compounds needed by the body to work properly [36] . As stated in the digestion section, when coming from food, they are absorbed from the digestive system and carried by the blood to all parts of the body. When there is extra or excess in the body it is not stored but excreted out. Nutritionists do not have a firm suggestion on the intake vitamins because intake greatly depends on the individuals needs at the time. If pregnancy, disease, emotional stress and or old age are present then the recommendations will change.

After looking at two systems of the body closely in addition to nutrition, the essential question still remains. "What should I eat to be healthy?" As it relates to the two systems discussed in the background section, experts have a lot to say on this matter. In order to keep your central nervous system stay healthy, researchers suggest eating a variety of nutrients in order to keep the mind cognitively sharp, boost memory and rid the system of free radicals.

Vitamin A, B9 (folic acid), B12, B6, E, and lipids were found to be the best to support the CNS. Vitamin A promoted higher learning and improved short-term memory by affecting brain cells in the hippocampus. Folic acid or vitamin B9 is essential to CNS development in the embryo. It also has antioxidant that protects and nourishes the blood vessels of the CNS. Vitamin B12 & B6 also support thinking and short-term memory. B12 is needed to produce myelin, the protective covering along the axon. This is key for protecting the brain against age-related degeneration. A diet with varied proteins and fat sources is also suggested as omega-3 lipids make up a portion of nerve cells [3738] .

The digestive system is the site of absorption of all nutrients. In order for this system to work efficiently several nutrients are needed, specifically, vitamin B-complex, vitamin C (absorbs iron), and Folic acid, which helps in the production of vitamin K [39] . These complex B vitamins function to helps break down proteins and get rid of waste products in the body [40] .

Strategies

Throughout this unit students will engage with the content in a variety of ways. Lessons in this unit will follow the Emery Unified School District's four-part delivery model for instruction. The districts four-part model for instruction consists of a warm-up (5 minutes), mini-lesson (10 - 15 minutes), small group or independent practice (35 minutes) and summary (5 minutes). The warm up or transitions are intended to be short activities that quickly engage students in the subject matter for the period. Initially, we will record and reflect on our breakfast, snack and lunch for the first few days by writing a description or drawing a diagram.

The mini-lessons for this unit will activate and focus prior knowledge through the use of key questions, partner discussions and whole group sharing. The objectives and key questions will be posted for each lesson. The following are examples of questions that will be used throughout the unit. What did you eat? How do/did you feel after eating? Why do we eat food? What happens on the inside of your body after you eat your food? What does the inside of your body look like? Presenting students with an objective and key question helps to focus their prior knowledge toward new information.

Using an inquiry chart the students and I will compile two lists related to the topic. The two headings will be "What do we know?" and "What do we want to know?" Observations charts will also be used to introduce students to real images of body systems, organs, professionals and tools used by these professionals. As students move through different stations, I will monitor and record questions and observations students make from these charts. These opening activities and discussions will give me a clear picture of current knowledge, misconceptions, and burning questions students have about this topic before presenting new information.

During other lessons in this unit I will model on an input chart the structure of the central nervous system and digestive system while discussing their functions. An input chart is an enlarged image lightly sketched on butcher paper. In front of the class the teacher uses colors to bring the image alive before the students. Careful attention is given to the colors used as it supports the organization of the information presented. Posters are posted and revisited throughout the unit as a resource. As additional content is presented it is added to the poster. Later in the unit these input charts will be used to identify the foods and vitamins that support each system.

In small collaborative groups or independently, students will work on specific task related to each lesson. Working in small groups increases student participation, encourages use of language as well as provides an opportunity for students to practice new vocabulary and concepts. To provide opportunities for building and solidifying new knowledge certain task will be repeated. For example models of the two systems will be created with the class, in small groups and independently. Finally, the same format will be used for assessing students. Using a processing grid as a class we will chart new information to support organization of new vocabulary and terms. All students will select an area of the unit in which they would like to be an expert. Working with a partner or in a small group, students will select text from the provided library of leveled and early chapter books to gather more information on their selected topic. While students are working on task I will work with a small group of students to review or pre-teach concepts and vocabulary. I will also use this time to check in with "expert" groups to review new information they have come across in their independent reading.

At the close of each lesson I will lead students in summarizing activities to see how effectively we answered questions and met posted objectives. I will carefully listen and note how well students are able to articulate their understanding of the two systems in the body, tell the story of how humans get nutrients from the foods we eat or vitamins we take. During this portion of the lesson I will prompt students to look back at our initial inquiry chart to post new understandings, new questions, and clarify misconceptions. It is important to model for students at this age how new knowledge can be acquired by integrating it with prior knowledge. Utilizing exit tickets is a useful strategy for a quick informal assessment of how students understand the information presented in the lesson. The exit ticket strategy is an interactive question and feedback system teachers can use to assess student understanding. This can be done in a variety of ways verbally, on paper or electronically. Asking students to name two specific structures and tell their function in their own words is immediate feedback that I will use to make adjustments in pacing and reengagement throughout this unit.

At the end of the unit students will again record breakfast, snack and lunch choices and reflect on how this has changed or remained the same. Students will also demonstrate their understanding through classroom presentations of their expert topics, individual task posters or models of the two systems of the body properly labeled.

Lesson Activities

Lesson One: Inside and Outside My Body

Common Core Health Standard:

Growth - 1.3G Identify major internal and external body parts and their functions.

Speaking and Listening - 1. Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

Objective: The objective of this lesson is for students to accurately identify major internal and external body parts and their function.

Warm Up (10 minutes): "Working with your team table write or draw as many body parts as you can in five

minutes. Be ready to tell where it is located and what it does." After five minutes students will be called to the carpet areas using the signal words for the day, internal and external. Once seated on the carpet each group will share their list as I write a class list to be posted later. After each group has shared I will go through the list again asking, "Is this an internal or external part of your body? How does it work?" Using a marker to circle the external parts on the list the mini-lesson will begin.

Mini-Lesson (15 minutes): The teacher divides a blank piece of poster paper into two sections labeled, "External"(outside) and "Internal"(inside). On the external side of the poster an outline of a student in uniform will be traced in three colors. Three cards labeled head, chest and abdomen will be presented to the class. Three different students will place them on the chart where they think it should go. The teacher defines to students that external means outside and internal means inside. The teacher uses reinforces, small tickets that have pictures of lesson vocabulary or body systems, to encourage use of these words when sharing ideas. The teacher points out to students how these three parts of the body are separated: the neck separates the head from the chest and the diaphragm separates the abdomen from the chest. The teacher tells students that you have created a diagram or picture with labels of the external parts of the body. Using the list created other labels will be added to the chart. Explain the task to be completed at their desk. 1. Label a diagram of the external parts of the body. Students must include the three parts discussed in the mini-lesson. 2. Create a diagram of the inside of your body.

Model: Explain that the diaphragm is an internal part of the body. Have students inhale deep to show the space between the chest and abdomen expands. Using the second outline of the student body on the poster, draw the location of the diaphragm. Ask students, "What do you think is on the inside of your head?" Tell students it is ok to shout out the answer? Brain Processing aloud draw what you think the brain looks like.

Independent Practice: 1. Label a diagram of the external parts of the body. 2. Create a diagram of the inside of your body. 3. Write any new questions that come up in your notebook.

Summary: Revisit the words external, internal, and diaphragm with students and post each word on a vocabulary word grid to stay on the wall throughout the unit.

Activity - Stomach In A Bag

Standards: 1.3G Identify major internal and external body parts and their functions

Objective: Demonstrate how the stomach works in the digestive system

Warm Up: Ask students to discuss with partners "How does your stomach work?"

Mini-Lesson: Read "Guts: Our Digestive System" by Simon, Seymour or a similar text. Tell students today we will enjoy the treat of a smoothie. Setup a blender then add in lemon juice, strawberries and bananas. Tell students today you will take part in an experiment to show the stomach works to break down food to be used by the body. Remind students that food is of no use to the human body until it is broken down. Explain that as you eat the stomach has gastric juices inside that help to break the food down. Lemon juice in the smoothie represents these juices. Sliced up food represents the chewed food. Tell students that their hands will be use to represent the muscles that contract to mix the contents of the stomach.

Activity: Pass out large Ziploc bags to all students. Next add in foods described above making sure to release as much air as possible. Have students drop the small bag into the larger bag and lay flat on the table to get

the air out. Using a timer, have students squeeze the bag for 1-2 minutes and observe. Lead students in a discussion about how we get nutrients from food. Have students remove the small bag from the larger bag to closely observe the change.

Individual Task: In science notebooks students are to record their observations using pictures and words.

Lesson Two

Objective: Introduce students to the structure and function of the central nervous system.

Key Question: How does your body know what to do?

Warm Up: Give students a number of simple directions to follow such as: Raise your hand. Touch the top of your head then wave at me. Make a silly face. Post the key question for students to discuss and answer in their science notebooks. Record student ideas on the board. Expect students to respond with misconceptions of: "It just knows already. I just think it and my body does it." These will be clarified as the unit progresses. Next, call students by team to gather tissue paper - 2 gray, 1 cream, 1 blue.

Mini-Lesson: Give students the following directions: Take 1 gray sheet and crumple it so that it fits into both hands. Lay the 2 nd piece flat and begin to fold is horizontally (side to side) so that it looks like a fan when you are done. Next, take the cream colored sheet and twist it into a long structure. Using the blue sheet of tissue paper carefully make small strips by tearing the tissue then roll it between your hands or on your desk until it looks like a thin worm.

Once all tissue pieces have been created have each student place their tissue in the box that matches the colors they have. Make sure students cannot see into or through the box or bag. Once they are seated on the carpet tell students that tissues in the body that are the same get together to form "organs". These organs work together to form a system in the body. "We will study one of these systems today." Tell students the name of the system is the central nervous system. Reach into the bag or box and reveal the organ created by all the tissues. Gray - Brain, Cream - Spinal Cord, and Blue - Nerves

Assemble the pieces the students have created to make a class model of the central nervous system. As you affix the tissue pieces together explain the function of each organ to students. Label the model with vocabulary words and descriptions of functions from the mini-book students will create.

Independent Activity: Students partner up to practice reading segments of the mini-book. After reading text students will color the images according to the information in the text of the book. Finally, students need to make one horizontal cut through each page to separate pages to be assembled into a mini-book.

Lesson Three: "Get The Message, Send A Response"

Standards: Nutrition and Physical Activity 1.3G Identify major internal and external body parts and their functions.

Objective: Introduced the students to how messages are sent and received by neurons. Students will build individual neurons and the class will construct a network to show our understanding.

Warm up: Pose the following questions for students to answer. "What happens when you touch something that is very hot?" *Students should respond with the motion of jerking quickly to move away quickly.* Ask, "Why is it

important to react fast in situation like that?"

Mini-Lesson: Using the class model of the central nervous system point out how components of the nervous system work together to transmit signals very quickly. Reflex responses are especially fast because the signal from the nerves can be sent directly to the muscles through the spinal cord without passing through the brain first. Next ask students to respond to simple math problems and identify shapes. "What is 2 + 2? Who many fingers do you have? What shape has only three sides? What shape is completely round? Then follow up these questions with, "Did it take a long time for your brain to figure out the answers? Did it take a long time for your brain to send the message to your lips to respond? Did it take your brain a long time to make your raise your hand because you knew the answer?" Explain to students that the CNS is working together very rapidly all the time.

Display a picture of a neuron. Tell student that this is one kind of neuron in our body but there are many different kinds in the body. All neurons are designed to carry messages through out the body. Here is how it is done! Point out the "message-collector" parts (dendrites and cell body) and the "message-giver" parts on the two neurons displayed. Tell the students that the fatty bead-like structures are called myelin sheaths and they protect the axon and speed up message delivery.

Model: Using wave-like motions or a dance move popularly know as the snake, demonstrate this action using yourself as the neuron. Pretend to receive a message in your right hand, and then move your arms and chest in a wave-like motion toward your left hand being careful to point out, messages are sent in one direction. Model this with one other student and pass a message on to them. Allow students 3 minutes to try it out.

Class Activity: Play the class game of telephone. Open the classroom door. Have students line up arm length apart. Whisper to one student, "Shut the door" while giving them a piece of yarn. As the message is passed the students must pass the yarn and the verbal message. Demonstrate the function of the myelin sheath by tapping a student and letting them skip the line to deliver the message to move it to the end faster. Repeat as needed to demonstrate the concept, again emphasizing the vocabulary and location of the dendrite, cell body and axon. Show students that the messages always come in to the dendrite and messages are given by the axon.

Next show students photos of different neurons as well as a network of neurons to show how they work together. Show students the short video on nerve impulses from book *The Human Body Book*, by Steve Parker

Guided Practice: Pass out a student copy of two neurons and have them complete it. Make sure that student understand that messages flow in one direction only through each neuron. Once they have complete the page accurately it is to be pasted into their science notebooks.

Independent Practice: Provide different materials for students to create their own neurons. Explain to students that their notes are flat (2D) but in reality neurons have different shapes in (3D). Redirect student to their science notebooks (two neurons page) as a resource if they get stuck.

Summary: At he end of this lesson provide masking tape to students to create short myelin sheaths segments along the axon for their nerve cells. Using their models, ask students to identify the "message-collectors" (dendrites and cell body), and the "message-giver" (axon).

Optional: Display the completed models individually or place them together to create a network of neurons for a class display.

Bibliography

Aldridge, Susan. *Magic molecules: how drugs work*. Cambridge, UK: Cambridge University Press, 1998. This text explains how drugs can be used for pleasure or to maintain health. It provides information to the layman of what is happening inside the human body as it relates to drugs.

Bond, Owen. "Vitamins To Improve Central Nervous System Health | LIVESTRONG.COM." LIVESTRONG.COM - Lose Weight & Get Fit with Diet, Nutrition & Fitness Tools | LIVESTRONG.COM. http://www.livestrong.com/article/414013-vitamins-to-improve-central-nervous-system-health/ (accessed July 10, 2012). This website list specific vitamins and how they help to support the central nervous system.

"Curriculum Frameworks & Instructional Materials - Curriculum Resources (CA Dept of Education)." California Department of Education. http://www.cde.ca.gov/ci/cr/cf/documents/glc2ndgradecurriculum.pdf (accessed June 18, 2012).

Iliades, MD, Chris . "Digestive Health Home - Digestive Health - Everyday Health." Health Information, Resources, Tools & News Online - EverydayHealth.com http://everydayhealth.com/digestive-health (accessed July 12, 2012). This website gives information on the vitamins that support digestive health. A list of vitamin rich foods is also supplied.

Jensen, Eric. *Teaching with the brain in mind*. 2. ed. Alexandria, Va.: Association for Supervision and Curriculum Development, 2005.

Kent, Michael. *The Oxford dictionary of sports science & medicine*. 3rd ed. Oxford: Oxford University Press, 2006. This dictionary covers all the major areas of sports science and medicine including anatomy, biomechanics, exercise physiology, nutrition, sports psychology, sports sociology, sports injuries and training principles.

Macaulay, David, and Richard Walker. *The way we work getting to know the amazing human body*. Boston: Houghton Mifflin Co., 2008. The text gives an introduction to the philology of the human body using very direct descriptions and engaging illustrations.

Nuble, Â Charlene J.. "The Beneficial Effects Of Vitamins On Your Digestive System." Health Guidance - Free Health Articles. http://www.healthguidance.org/entry/4574/1 (accessed July 10, 2012).

This site discusses the positive effect of vitamins in the digestive system.

Parker, Steve. *The human body book*. New York: DK Pub., 2007. This book provides an overview of human anatomy and physiology using vivid illustrations. It examines the structure and functions of organs, tissues, cells, muscles, and bones, and also covers diseases and disorders.

Scott, Ann Senisi. *Body structures & functions*. 11. ed. Australia: Delmar/Cengage Learning, 2009. This text gives a clear and concise description of each system in the body as well as diseases associated with them. This book is ideal for introducing learners with little or no science background to anatomy and physiology.

Stone, B. "How to Keep the Nervous System Healthy with Food - Yahoo! Voices - voices.yahoo.com." Yahoo! Voices - voices.yahoo.com. http://voices.yahoo.com/how-keep-nervous-system-healthy-food-9451289.html?cat=5 (accessed July 10, 2012).

This article tells what nutrients are important to keeping the nervous system healthy and list foods rich in vitamins.

Appendix

The following California State Standards and Common Core Standards are address through this unit.

Nutrition and Physical Activity

1.3G Identify major internal and external body parts and their functions.

1.3N Discuss the benefits of eating a nutritious breakfast everyday.

1.4N List the benefits of healthy eating (including beverages and snacks).

5.2N Compare and contrast healthy and less-healthy food choices

7.1N Examine the importance of eating a nutritious breakfast everyday.

8.1N Practice making healthy eating choices with friends and family

Throughout this unit students will develop their own questions and perform investigations as they utilize the Science standards below.

4d Write or draw descriptions of a sequence of steps, evens and observation

4f Use magnifiers or microscopes to observe and draw descriptions of small object or small features of objects

4g Follow oral instruction for a scientific investigation

In high performing science classrooms students have a command of the academic language associated with the subject matter. Work produced and displayed also demonstrates student understanding. The content of lesson in this unit will be used during reading and writing blocks. The following standards will be used from English Language Arts

Key Ideas and Details

1. Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text.

Craft and Structure

5. Know and use various text features (e.g., captions, bold print, subheadings, glossaries, indexes, electronic menus, icons) to locate key facts or information in a text efficiently.

10. By the end of year, read and comprehend informational texts, including history/social studies, *science*, and technical texts, in the grades 2-3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

Writing

Research to Build and Present Knowledge

7. Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

8. Recall information from experiences or gather information from provided sources to answer a question.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Speaking and Listening: Comprehension and Collaboration

1. Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

a. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).

b. Build on others' talk in conversations by linking their comments to the remarks of others.

c. Ask for clarification and further explanation as needed about the topics and texts under discussion.

Vocabulary Acquisition and Use

4f. Use glossaries and beginning dictionaries, both print and digital, to determine or clarify the meaning of words and phrases ***in all content areas***

Notes

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1. Steve Parker, *The Human Body Book* (New York:DK Publishing 2007), 14.
2. Ann Scott and Elizabeth Fung, *Body Structures & Functions* (Australia: Delmar/Cengage Learning 2009).
3. Parker, *Human Body*, 68-69.
4. Parker, *Human Body*, 70.
5. Eric Jensen, *Teaching With the Brain In Mind*, (Alexandria, Va.: Association for Supervision and Curriculum Development, 2005) 8.
6. Parker, *Human Body*, 71.
7. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
8. Parker, *Human Body*, 73
9. Jensen, *Teaching With*, 8.
10. David Macaulay and Richard Walker, *The Way We Work: Getting to Know the Amazing Human Body* (Houghton Mifflin Company Boston 2008), 156-157.
11. Parker, *Human Body*, 75.
12. David Macaulay and Richard Walker, *The Way*, 164-165
13. Parker, Human Body, 76.
14. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
15. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,

16. Jensen, *Teaching With*, 10.
17. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
18. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
19. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
20. Parker, Human Body, 80-81.
21. Parker, Human Body, 82
22. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
23. Parker, Human Body, 172.
24. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
25. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
26. Parker, Human Body, 172-173.
27. David Macaulay and Richard Walker, *The Way*, 99-112.
28. David Macaulay and Richard Walker, *The Way*, 114 -121.
29. Parker, *Human Body*, 174-177.
30. Ann Scott and Elizabeth Fung, *Body Structures & Functions*,
31. David Macaulay and Richard Walker, *The Way*, 142
32. Essential Vitamins for Digestive Health, last updated October 6, 2011, http://everydayhealth.com/digestive-h
33. Ann Scott and Elizabeth Fung, *Body Structures & Functions*
34. How to Keep the Nervous System Healthy with Food, last update September 28, 2011, http://voices.yahoo.com/how-keep-nervous-system-healthy-food-9451289.html?cat=5.
35. Ann Scott and Elizabeth Fung, *Body Structures & Functions*
36. Essential Vitamins for Digestive Health, last updated October 6, 2011, http://everydayhealth.com/digestive-h
37. Vitamins to Improve Central Nervous System Health, last update August 18, 2011, http://www.livestrong.com/article/414013-vitamins-to-improve-central-nervous-system-health/
38. How to Keep the Nervous System Healthy with Food, last update September 28, 2011, http://voices.yahoo.com/how-keep-nervous-system-healthy-food-9451289.html?cat=5.
39. The Beneficial Effects Of Vitamins On Your Digestive System, 2005, http://www.healthguidance.org/entry/4574/1
40. Essential Vitamins for Digestive Health, last updated October 6, 2011, http://everydayhealth.com/digestive-h