Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2006 Volume VI: Anatomy and Art: How We See and Understand

Drawing Upon Our Five Senses

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Introduction

Incorporating visual arts into an inquiry based science curriculum is an effective way to promote and ensure learning. According to the State of Connecticut's Arts Curriculum every child's artistic ability should be cultivated [1]. Through this unit students will have the opportunity to both create their own art work and study the work of others. According to the State Board of Education, it has been shown that, "Arts study develops habits of sensory awareness and sharpens perception, their by enhancing students' capacity for learning". [2] So not only are students going to be learning about the five senses in this unit, but also learning how to enhance them.

Teaching science through art also encourages a higher level of questioning and thinking. Educators strive to have students reach levels of analysis, synthesis, and evaluation. Students can memorize and apply information, but observing and creating art allows students to participate in more challenging thinking. According to Resnick and Klopfer, art provides students with the opportunity to compare art work, debate issues, defend ideas, make judgments, and evaluate their own and others work. [3] These higher level thinking strategies will transcend into science based themes providing a more enriching experience.

Making curriculum choices based on student interests is also a common and effective strategy used by educators. The students who attend the magnet school I teach at do so because of their interest in the arts. According to Elliot W. Eisner, a teacher should make decisions based on the particular students. In this case, because of the students' strong interests in the arts, drawing, creating, and constructing can be used to foster learning. [4]

Two fifth grade classes from Betsy Ross Arts Magnet School will be participating in this unit, however it could be easily modified to accommodate other grade levels. Like the 550 students who attend Betsy Ross my classes are diverse. While accommodating students from various parts of the state, over half of the students are originally from the New Have Public School System. One of the participating classes will consist of students who test above the fifth grade level in mathematics and the other participating class is of average and below average mathematics abilities, according to STAR Math and Connecticut Mastery Test results. On account of their differences in ability, their mathematics curriculums differ, but their science curriculums are the same. Some modifications will be made in both classes for students with additional needs. Both classes

are instructed based on the New Haven Public School Fifth Grade Science Curriculum. At Betsy Ross out mission is to fuse both the arts and academics together to build a richer and more meaningful education. This unit aligns with the goals of Betsy Ross by blending science and visual art together to encourage discovery and learning.

Objectives

The objectives for this unit are for students to observe and create artistic representations, technological images, and scientific diagrams to learn the five senses, the structure and function of the corresponding organs, and how the senses are connected to the human brain.

Content Standards

This unit combines art and science going beyond the textbook to educate students about their world, while also meeting required standards. This curriculum unit achieves the recently updated content standards proposed by the Core Science Curriculum Framework proposed by the State of Connecticut and supported by the New Haven Public School System. More specifically, this unit addresses three of the four established content standards: How sounds and light are forms of energy, how perceiving and responding to information about the environment is critical to the survival of organisms, and how humans have the capacity to build and use tools to advance the quality of their lives. Each of these standards corresponds to a set of expected performances and this unit addresses six out of nine listed below.

Describe the structure and function of the human senses and the signals they perceive.

Describe the factors that affect the pitch and loudness of sound produced by vibrating objects.

Describe how sound is transmitted, reflected and/or absorbed by different materials.

Describe how light is absorbed and/or reflected by different surfaces.

Describe how light absorption and reflection allow one to see the shapes and colors of objects.

Compare and contrast the structures of the human eye with those of the camera.

Unit Goal

The unit goal is for students to identify the fives senses, name their corresponding organs, label the organs parts, explain their function, and their connection to the brain. Students will demonstrate their completion of these goals creating a five sense scrapbook with artistic representations of sense organs and written descriptions of their functions.

Unit Overview

The unit is categorized into six sections, addressing the nervous system and the five senses. Each section will be introduced with an array of illustrations that will consist of scientific diagrams, artistic representations, and technological views. These pictorial representations will serve as a map guiding through each lesson. At the conclusion of each section scientific connections, art connections, and students art connections may be listed. The scientific connections contain a list of applicable websites that can be used to teach and enhance the lesson. The art connections hold an array of media styles depicting different representation of the nervous and sensory system. The student art connections list a corresponding art activity to be created by the students for the scrapbook.

Students will learn the parts of the brain that are affected by each sense and create a colorful depiction of what they have learned. Through the visual representations, as well as creating their own illustrations, students will learn the five senses, the structure and function of each corresponding organ, the senses connection to the brain, and how this information connects to technology and art in the real world.

There is an immanent connection between visual art and our senses. In order to view art or discover scientific concepts one needs to unlock these senses. It has been said that, "Art as well as science provides a fundamental lens of understanding through which we can view and interpret the world in which we live." [5] Through this as educators we must provide the obvious connection for children to ensure success. The proposed curriculum will allow me to create a fifth grade unit that will specifically meet the needs of both the school system's standards and the student's interests. Students will not only learn about the structure and function of the five senses, but also about viewing and creating art.

Introduction to the Five Senses

Before discussing the five senses with the students I will have the students view Jacques Linard's "The Five Senses" (1638). Students would begin by stating exactly what they see on the painting without interpretation or judgment. Prompts such as, "What do you see?", "What colors do you see?", and "Does anyone agree or disagree?" will be asked. After all areas of the painting are addressed I will have the students speculate what they believe the artist is trying to show. Whether or not the students are able to determine what the painting is depicting I would then tell them the title of this painting. This discovery would potentially lead the students

into a discussion about the five senses, what they are, and their corresponding organs. After facilitating this discussion I will have the students view a more recent work entitled "Morning Coffee " by Sarah Scott, (2006). This artist's work was created based on the theme the five senses. Students will also discuss what they see, how this piece of artwork is connected to the five senses, and compare (similarities and differences) it to "The Five Senses".

There are five main senses that correspond to specific organs. As per our earlier discussion I would have student name the five senses and hypothesis the complimentary organ. The sense of vision and the eye, the sense of hearing and the ear, the sense of taste and the tongue, the sense of smell and the nose, and the sense of touch and the skin. I shall explain that each of these senses are important in collecting information of the world around us. While each of these senses are important, the nervous system is the hub. The nervous system allows the body to interpret the collected information and react.

Art Connection

"The Five Senses", Jacques Linard, (1638)

http://www.art.com

"Morning Coffee ", Sarah Scott, (2006)

http://www.sarahscottart.com/artwork/index.album?i=14

The Nervous System

The nervous system is an intricate system that controls the body, including thoughts, emotions, memories, actions, and sensations. The nervous system can be simplified by dividing it into its two major divisions: the central nervous system and the peripheral nervous system. The central nervous system consists of the brain and spinal cord, while the peripheral nervous system includes the body's nerves. It is important to note that the peripheral nervous system has the ability to heal itself, while the central nervous system does not.

Student Art Connection

As page one of the scrapbook, students will create a replica of the human nervous system, highlighting the three main parts. Students can either create a small scale version for their scrapbook or a life size version by tracing a classmate on chart paper then photograph it for the scrapbook. Either way students can draw (or trace) an outline of the body and add the main components of the nervous system using a variety of materials. For example, students could use stretched out cotton for the brain, pipe cleaners or popsicle sticks for the spinal cord, and yarn for the nerves. Students will view a scientific diagram of the five senses and compare it to the sculpture, Reality processor, by Brain Carroll. This will allow students to discuss why they believe the artist made particular choices and assess the piece.

The Brain

While the brain is by far the most complex sections of the nervous system, scientists know more about the

brain today then ever. With this in mind, as an educator it is important to provide only age appropriate information to students. At the fifth grade level student can understand and retain basic brain structure and function.

The human brain is the control center of the central nervous system. The brain controls reason, intelligence, emotions, memory, cognition, sensory systems, heart rate, blood pressure, and more. [6] There are three main parts of the human brain. First, the cerebrum is the largest and the most visible region of the brain. Its two hemispheres control our body's language and communication, movement, olfaction, memory, and emotions. The second part of the brain, the cerebellum, is also in two distinct hemispheres and is located below the cerebrum, in the back of the brain, above the brain stem. The cerebellum, which in Latin means "little brain", coordinates voluntary motor movement, balance, equilibrium, and muscle tone. The brain stem, the third part of the brain, is the major connection among the cerebrum and cerebellum and the spinal cord. It plays a vital role in attention, respiration, regulation of heart rhythms, and sound localization.6, [7]

Students will view a series of work by Georgia O'Keefe and then view and discuss "Georgia O'Keefe's Mind in Bloom" by Alexandra Person. Students will have the opportunity to analyze and assess the art work to determine why they believe that it won first place in the Brain Art Competition 2004.

Art Connection

"Reality Processor", Brian Carroll, Sculpture

http://www.mnartists.org/work.do?rid=99761

"Georgia O'Keefe's Mind in Bloom", Alexandra Person, painting, (2004)

Brain Art Competition 2004 - First Place

http://www.sfn.org/baw/photos.cfm

"Windows of the Mind", Eugenia Algaze Garcia, pencil, (1986)

http://www.mindful-art.com/logo%20brain%20-%20web.JPG

Scientific Imaging

Students can participate in an interactive 3D tour of the brain to better understand its structure and function.

http://www.pbs.org/wnet/brain

Students Art Connection

Two projects or a combination of the two projects can be created to represent the brain. For one project students can fold a piece of paper into four even sections. In each section students can draw a pictorial representation of the brain each from a different view. For example, the first square can display a front (frontal) view of the brain, the second square can contain a (side) lateral view, the third a back (posterior) view, and the fourth a midline (sagittal) view. Or students could create one view of the brain to fill the entire piece of paper. Then create a small picture of an eye, ear, nose, mouth, and hand to be cut out and displayed on the part of the brain that controls the specific sense. The brain should be colored, labeled, and functions

described.

Medical Imaging

While learning about the complex brain students can be introduced to the various forms of medical imaging that are available, including a x-rays, ultrasound, CAT Scan, MRI and PET Scan. While all are not routinely used to study the brain, their limitations can be incorporated into the discussion. Corresponding internet sites are listed at the conclusion of this section which are recommended viewing while teaching about medical imaging. The students participating in this unit will view these images as part of a power point presentation. My goal is not for students to memorize the components of each system, but rather ultimately understand the technological possibilities and continuous advancements.

Most students are familiar with an x-ray. Each student has generally had a bone or even their teeth x-rayed at one point in their life. Educators can use this information to build on students' prior knowledge to determine whether or not a brain could be seen when x-raying the head.

X-rays are a form of electromagnetic radiation discovered by William Conrad Roentgen. Prior to his discovery in 1895, doctors had no way to determine what was going on with the body, other than cutting it open. Luckily, Roentgen happened upon the x-ray, which could be used to view the internal structure of the human body. In their most simplistic form, x-rays work by photon energy being released and absorbed by matter. X-rays travel through the person's body and unabsorbed energy is displayed on a film. Air, absorbs no photons or energy so it appears black on the film, while bone (calcium) absorbs the most energy appearing white on the film. The denser the material, the more energy that will be absorbed. Fat will appear as a dark gray and muscles, organs, or blood (water) will appear gray.

"Cranial ultrasound uses reflected sound waves to produce pictures of the brain and the inner fluid chambers..." [8] Ultrasounds are most commonly used during pregnancy to determine the health of an infant. However, cranial ultrasounds can also be used on newborns because ultrasound cannot pass through the bone. At early ages the skull is not yet fused together allowing doctors to examine infants up to the age of 18 months for issues due to development or disease of the brain. The ultrasound probe is placed over the "soft spots" on the infant's skull. On adults, ultrasound can be used during brain surgery following removal of part of the skull to determine brain mass or check for bleeding. [9]

A computerized axial tomography scan (CAT Scan or CT) uses x-ray technology to form a three dimensional computer image of the internal body, while allowing doctors to view the body or brain in sections or slices. Instead of the one angle view that an x-ray provides, the x-ray beams moves all around the person allowing the computer to organize the information from hundreds of different angles.

Magnetic resonance imaging (MRI) has progressed greatly from their conception in 1977. Imaging that used to take hours, now only takes minutes. Using magnets and radio wave technology an MRI is able to produce a two or three dimensional image. Unlike the CAT scan which only can be viewed on one plane, the MRI can be viewed on three different planes. For example CAT scans can only interpret images cut axially, imagine a loaf of bread sliced. However, an MRI can also display images cut on a "...sagittal plane (slicing the bread side-to-side lengthwise) and coronally (think of the layers of a layer cake) or any degree in between, without the patient ever moving." [10]

Finally, positron emission tomography (PET) scan allows doctors to view function of the body, rather than the structure. Patients are injected with a low dose radioactive compound that is isolated to the area of the body

being studied. The PET scan will produce a two or three dimensional image of the area of study. "PET scans of the brain are used to evaluate patients who have memory disorders of an undetermined cause, suspected or proven brain tumors or seizure disorders that are not responsive to medical therapy and are therefore candidates for surgery." [11]

Medical Imaging of the Brain

X-Ray - http://www.faqs.org/health/images/uchr_02_img0179.jpg

Ultrasound - http://www.ob-ultrasound.net/images/cscan2.jpg

CAT Scan - http://www.parhammedical.org/Parham/Illness/Brain%20Pressure.htm

MRI - http://www.lpg.man.ac.uk/web_page/photomedicine/MRI_image.htm

PET Scan - http://faculty.washington.edu/chudler/image.html

Student Art Connection

Students are going to make a hand booklet to add to their scrapbook. First, students will trace their hand on white paper, observe their hand, and color what they observe, including skin color, pores, hair, etc. Next students will trace the same hand on black construction paper and use a piece of white chalk to predict what their hand would look like in an x ray. Finally, students would trace their hand on another piece of black construction paper and draw a replica of what a hand x ray actually looks like. All three hands should be cut out, layered, stapled together, and added to the book. Students could add a written component comparing the similarities and differences between the prediction and actual depiction.

The Spinal Cord

The spinal cord begins in the brain and ends at level vertebral L1, that is, it ends two-thirds the way down the spinal column. There are 31 pairs of spinal nerves extending off of the spinal cord containing thousands of sensory and motor nerves. These nerves help the body transport information to and from the brain and to other parts of the body. The spinal cord basically controls almost every muscle from the neck down, transmitting sensory information to the brain. Its importance to understanding the world around us is imperative. As a result, the spinal cord is protected by the strong bones of the spinal column called vertebrae.

The Nerves

The peripheral nervous system is made up of hundreds of nerves. Each nerve is like a cable wire filled with smaller nerve cells or neurons. While most nerves connect through the spinal cord, [12] cranial nerves connect directly to the human brain. Information from your five senses is received through one of the many sensory nerves and the brain will interpret the message and react via the motor nerves. The sciatic nerve is the longest nerve in the body, running from the spinal cord down the leg to the big toe. Students will participate in activity to better understand how the nervous system works. With a class in a large circle each person will put their right hand on the persons shoulder standing to their right. One person starts by squeezing the person's shoulder next to them. I will clock the time it takes to make it around the full circle and record the results on the board. Next, students sit and squeeze the person's foot to the right of them. Again, I record the time it takes for the message to pass all the way around the circle. It should take longer when the information has to

travel from the foot to the brain than the shoulder to the brain, because the information has less of a length to travel.

The Senses

The Eye and the Sense of Sight

Eye sight is usually considered the most important sense, "according to one estimate, four fifths of everything we know reaches our brain through our eyes."12 In order to understand how the eye functions, it is important to be aware of the structure. Looking at the external eye, students are able to see three parts of a person's eye. The sclera, which is the white part of the eye or the outer layer of the eyeball made of tough, white, fibrous tissue that keeps the shape of the eye. The iris, which is the colored part of the eye made up of strong muscle and the pupil, the black part or hole in the middle of iris. The cornea is also on the external portion of the eye, because it is the transparent covering protecting the eye it cannot be seen. The cornea is a continuation of the sclera, but transparent so light can pass through.

The internal section of the eye contains the lens directly behind the iris. The multilayered lens is also transparent. Inside the sclera is the choroid, which is a thin, dark red layer containing blood vessels that nourishes the eye. Inside the choroids is the retina which contains light detecting cells. When going to the doctors for a physical or check up, the doctor has used an ophthalmoscope, an instrument used to view the retina.

Connecting the eye to the brain is the optic nerve, which transmits electrical impulses from the retina to the brain. Because the beginning of the optic nerve is located on the retina, it creates a blind spot in our vision. Students can view this blind spot through a simple activity.

Blind Spot Activity

http://www.exploratorium.edu/snacks/blind_spot.html

There are two fluid filled transparent sections of the eye that are separated by the lens. The smaller of the two is the aqueous humor which is a water like substance between the cornea and the lens. The vitreous humor, which is larger, is a gel-like material between the lens and the retina that helps the eye retain its shape.

In order to see, light must be reflected off an object (hence we cannot see in the dark) and pass through the cornea. The iris adjusts around the pupil to let in the appropriate amount of light. The light passes through the convex lens bringing the light together at a focal point. This focuses the image on the retina upside down. The image is transmitted to the brain for interpretation in the correct manner by way of the optic nerve.

Before exiting the eye through the optic nerve the image is displayed on the retina. The retina senses light using either rod or cone cells. The 125 million rods are named for their rod like shape. Rods have poor visual acuity but high dark sensitivity, specifically identify shades of gray and working well in dim light. Cones work in bright light identifying color and detail. There are approximately seven million cones in each eye and they are named for their more cone like shape.

There are striking similarities between an eye and a camera. Like the human eye lid a camera's shutter opens to take a picture. While a camera has no cornea, light must also pass through a lens. The diaphragm, like the iris, controls the amount of light entering the camera. Because the lens of a camera is also convex, the image is brought to a focal point and released upside down on the film. In a camera we move the lens to bring the image to focus, but in the eye we change the shape of the lens. Through chemical change the image remains on the film. [13]

Light

How does light help us see? Light travels as a wave. Imagine a sink filled with water. If a stone is dropped in still water, waves travel across the water from that spot. Unlike the waves in the water, light can travel through a vacuum, that is, it can travel without matter. These waves have four main parts. The crest is the highest point of a wave and the trough is the lowest point of a wave. The wavelength is the distance between the two crests or troughs and the amplitude is the height of the wave from it resting point to either the crest or the trough. Laying a slinky on the floor and waving it is a good way to simulate the movement and identify the parts of a wave. This can also be used when discussing sound waves.13

Light can be reflected, refracted or absorbed and these processes effect the way an image is viewed. Reflection occurs when light is replicated off an object. For example, when light hits the chalkboard some of the light is absorbed and yet some is reflected. The reflected light travels outward being perceived by the eye. The eye processes the image, sends the message to the brain, allowing us to see the chalkboard. The frequency will determine the color of the chalkboard.

Understanding how colored is viewed is an abstract concept for students to understand. Explanation will be necessary, as well as possible comparison to a rainbow. Using a rainbow as a platform to address color will help students understand the fundamentals of color. When light from the sun is passed through water droplets a natural prism is created. The rainbow is created by refracted or bent white light. When light passes from air to water it changes speed, causing the light to refract. Like a rainbow, when light passes through a prism "the different colors are refracted in different amounts, so the colors spread out…".13 When light hits the earth it radiates at different wavelengths. These different wavelengths form the various colors and hues we see. These different light wavelengths activate different combinations of rods and cones in the retina causes an electrical impulse to the brain to interpret the color.

Some objects we see also reflect an image. What items do we often look in to see our reflection? A flat mirror reflects light back to the eye the same size and shape it is received, allowing us to see an opposite image. The shape of a mirror can effect the image we see. For example, a concave mirror makes a mirror look smaller while a convex mirror makes an image look larger.

Scientific Imaging

Clear and accurate labeled and unlabeled schematic diagrams of the eye.

http://www.nei.nih.gov/health/eyediagram/index.asp

An image of a retina as seen through an ophthalmoscope.

http://webvision.med.utah.edu/sretina.html

Color blind tests and optical illusions that can be used for the section on vision

http://www.schools.net.au/edu/lesson_ideas/optics/optics_actsht1_p1.html

Art Connections

"Regular Division of the Plane with Birds", "Relativity", and "Circle Limit IV", MC Escher

http://www.mcescher.com

Student Art Connections

Students will diagram an eye and a camera and compare and contrast their structure and function.

The Ear and the Sense of Hearing

Sound is a pressure wave that is transmitted through the air and is received by the ear. Unlike a light wave, sound waves need matter in which to travel. A sound is produced by a vibration or back and forth motion of molecules. Molecules push together causing compressions. The distance from one compression to the next is what causes a wavelength. A high sound or pitch is produced when there is a high frequency, that is, there are many waves per second, while a low sound or pitch is produced when there are few waves per second. For example, a flute, a high pitched instrument can have up to 2000 hertz or waves per second. A tuba, a low pitched instrument can only have up to 350 hertz or waves per second. Different frequency tuning forks or instruments can also be used to listen and compare frequencies.13

In order to truly comprehend how one hears it is important to understand the ear's structure. There are three parts to the human ear: The outer ear, the middle ear, and the inner ear. The outer ear begins with the pinna, which is the cartilage filled fleshy part that is outside the head. The pinna's shape captures the carrying sound. Next is the ear canal, which is a long passageway to the middle ear. (Students love to learn that this is where ear wax is produced.) This is also where the doctor will use the otoscope to see the first part of the middle ear which is the ear drum or tympanic membrane. The sound will cause the ear drum to vibrate hitting the first of the three smallest bones in the human body, the hammer. The hammer vibrates hitting the anvil, and then the anvil causes a vibration of the stirrup. These three bones connect to the oval window which is the ending point of the middle ear. The inner ear contains the cochlea, which is a snail shaped canals filled with liquid. The sound travels from the cochlea to the auditory nerve which then passes to the brain. The semicircular canals, also filled with fluid, are used for balance. The eustachian tube, which connects the throat to the middle ear is used for transferring air.

What we hear can be effected by transmission, absorption, and the reflection of sound waves. Imagine a student yelling from outside the classroom door. Some of the sound will be transmitted through the door, some sound will be absorbed by the door, and some sound will be reflected off the door. The material of which the door is made from can and will effect how the sound is heard.

As stated above in order for sound waves to be perceived they need material to transmit through. The object or material that sound waves travel through can greatly effect how the sound is heard. Cold air slows the frequency of sound waves, while hot air speeds it up. Sound travels slower through wood and copper, than in glass and brick. Students can compare how sound changes depending on the material by taping their finger on their desk and listening to the sound, then tapping their finger on their desk with their ear on their desk. Again, students can use a glass or a plastic cup and put their ear on the cup to observe and compare the differences in sound based upon the material.13

As sound waves transmit through materials they are also absorbed by the molecules within the material. Sound is absorbed by all materials, even air. For example, thunder is heard louder the closer it is because the farther it is away, the more of the sound that is absorbed by the air. Sound absorption may seem as an abstract concept to students but have them consider the sound differences between a crowded restaurant and a crowded cafeteria. A restaurant is generally quieter because it is made with or filled with sound absorbing materials. Soft cloth materials, plants, specific types of plaster, and banners or flags all absorb sound. Generally these are absent from a school cafeteria.

Sound is reflected by hard, non-porous materials such as metal, wood, and concrete, such as a mirror reflects light. In a small room reflected sound may cause reverberation. As the sound reflects off the hard material, a garbled repeat sound is emitted. This can be damaging in an auditorium for a theatrical performance. However, engineers often us it to their advantage to trap noises from a highway to eliminate sound from traveling to neighboring houses. In a large area, reflected sound can cause one to hear an echo.

Art Connections

"Hearing", Jan Bruegel the Elder, 1617

"Cochlea Surrounded by Waves II", Julie Newdoll

"Self Portrait with Bandaged Ear", Vincent Van Gogh, 1889

The Tongue and the Sense of Taste

Students will begin this sense by observing their tongue in the mirror and identifying the tiny little bumps called papillae. While papillae look virtually identical, the round collection of receptor cells actually differs. Most, but not all papillae contain taste buds. It is possible that papillae can contain up to 200 taste buds, with the largest on the rear of the tongue. While there are approximately 9000 taste buds on your tongue, in order for a person to actually interpret taste, food must mix with saliva. Food breaks down and mixes with saliva allowing the taste buds to determine the flavor. [14]

Located on different parts of the tongue there are four main taste sensations which can actually be tasted without the assistance of the sense of smell. The sweet region is mainly located on the tip of the tongue and two salty regions on either side. Two sour regions are located in the rear sides of the tongue with one bitter region on the rear of the tongue. Few solitary taste buds are located in the middle region of the tongue. [15]

If taste buds are looked at under a microscope they look like bulbs with tiny hair like extensions reaching above the surface of the tongue. These hair-like extensions, called microvilli, receive the information that passes to the nerve that connects to the brain stem leading to the cerebral cortex on each side of the brain.

Art Connection

"Allegory of Taste" by Jan Bruegel the Elder (1618)

"Allegory of Taste" also by Jan Bruegel the Elder

"Taste", by Theresa Lucero

Student Art Connection

Students will create a taste bud collage. Using red construction paper students will cut out a tongue and label the four main taste sensations in the proper locations. The four taste sensations will be listed on the board and students will create a list of foods corresponding to each taste sensation. Using a combination of magazine pictures, newspaper clippings, and personal drawings students can cover the parts of the tongue with the correct corresponding foods creating a collage.

The Nose and the Sense of Smell

While the sense of smell is a primitive system, it is a valuable method of obtaining information from outside the body. Odor flows first into the nasal cavity with air that is breathed in.14 While the air flows into the lungs, the odor is received by the 20 million sensory olfactory cells that cover an area the size of a thumb nail or postage stamp that is located in the upper back part of the nasal cavity. The information travels to the olfactory bulb where the olfactory nerves carry the information to both sides of the brain in the cerebral cortex.15

Smell has many uses and can cause a number of reactions. Smells can alert of us of danger by identifying hazards such as smoke or chemicals. Smells also cause physical reactions. A pleasant smell of food can cause a person to salivate or stimulate gastric juices, while unpleasant odors can cause gagging .15 Our nose can also become accustom to the odors around us. After about 30 seconds exposed to a smell habituation occurs in which repeated exposure to the smell or stimulus produces a small response.

Our sense of smell faces other challenges. Long term complications also occur with in the nose as our age increases. Each year of our life we lose 1% of the olfactory cells in our nose. For example at the age of 20, approximately 80% of the cells function and at age 50, approximately 50% of cells function. This break down of olfactory cells not only effects our sense of smell, but also our sense of taste.

While it is our taste buds that decipher bitter, sour, sweet, and salty tastes, it is the odor molecules that travel from our through the passage way between the mouth and nose that gives us 70% - 75% of our taste sensation. [16] As a result, the common cold can causes difficulty for our sense of smell. Excess mucus is produced and increases the thickness of the lining on our nasal cavity making it difficult to interpret different odors.

Scientific Imaging

Students can view a digital image of human olfactory receptor cells processed by an electron microscope to better understand the three dimensional structure of cells.
http://darwin.iz.uj.edu.pl/iz/anatomy/jakub/grafika/o1b.html

Art Connection

"Sense of Smell One; Olfactory Garden", Julie Newdoll, (2002), is a mixed media representation of the olfactory receptor cells and the sense of smell. This painting also depicts the array of receptor cells located in the olfactory epithelium and incorporates it into a floral motif that represents a floral scent.

http://www.brushwithscience.com/Winter2002work/WinterSenses2002.html#Anchor-Garden-49575

Student Art Connection

Due to the strong sense memory connection students will create a picture of a memory they have associated

to a smell. Through modeling I will begin by having students smell items in unlabeled bags that will possible evoke a memory, such as cinnamon, pine needles, chocolate, or flowers. Rather than guess what the item is, students will attempt to recreate a memory from that smell. Students will draw a picture entirely in black pen, only using color on the object that releases the smell and memory. A written description can be attached describing how the sense of smell works and the memory the smell elicits.

The Skin and the Sense of Touch

Our sense of touch is controlled by the body's largest organ. The skin, which on an adult can weight 8 to 10 pounds grows faster and renews itself faster than any other organ in the human body.14 We rely on our skin to protect us, keeps our body at a certain temperature, and provide us with the sense of touch.

The skin has two main layers, the epidermis and the dermis. The epidermis contains no nerves, but is several layers of cell. New cells form at the base of the epidermis and work their way up to the surface of the skin pushing off dead skin cells. In the epidermis melanin is formed, which is the pigment that provides us with skin color. Skin covers the entire body, the thickest is found on the palms of hands and the soles of feet, while the thinnest is the eyelids.14

The dermis rests below the epidermis and is much thicker. The dermis contains blood vessels, hair follicles, sweat glands, muscle, and an array of nerves. The nerves in the dermis are all for touch, but each plays a different role in sensory perception. There are nerves to detect temperature, light and heavy pressure, pain, vibration, two-point discrimination, texture, and joint position. Touch also includes sensations from inside the body, such as muscle pain, cramps, headaches, etc. Touch information is conveyed up the spinal cord to the brain stem and finally to the cerebrum.

Art Connections

"Sense of Touch", Damon Winter, Photograph

http://www.poyi.org/59/02/

"Sense of Touch", Mohamed Hagelamin,mixed media http://www.mogallery.net/senseoftouch.html

Student Art Connection

Through observation students will search the building for 4 different textures. With a crayon students will create a rubbing of the texture and below it a description of how the object felt and how the information was passed through the nervous system. Students will repeat this process three addition times. Students can be challenged to locate objects addressing different types of nerves, i.e. temperature, pain, light touch, etc…

Lesson Plans

Final Project – Five Senses Scrapbook

Cover – Independently created cover combing information learned from all the five senses and nervous

system.

Page 1: The Nervous System - Individual drawings or picture of large recreation

Page 2: Written explanation of the nervous system and its three main parts

Page 3: The Brain – View Drawing or sensory collage

Page 4: Written explanation of the brain and the structure and function of its 3 main parts

Page 5: X-ray image – White chalk on black paper drawing

Page 6: Written explanation of how x-rays work, the differences between imaging machines, or how medical imaging has improved the quality of care for patients

Page 7: The Eye and the Camera - Diagram

Page 8: Compare and Contrast the Eye and the Camera

Page 9: Hearing Comic Strip- "Through the Ear" Comic Strip

Page 10: "Through the Ear" Comic Strip continued

Page 11: Taste Collage – Collage paper cut out with magazine clippings of foods

Page 12: Written explanation of taste collage

Page 13: The Nose Knows – Black pen memory drawing with object in color

Page 14: Written description of how the nose works and the memory represented

Page 15: Touch Rubbings – 2 rubbings of the room or school with description

Page 16: Touch Rubbings – 2 rubbings of the room or school with description

Back Cover – Written explanation of front cover: How all the senses were represented, how the nervous system was represented, what inspired the idea, and how does it represent what the student learned about the five senses.

Notes

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1 Paraphrased from The Arts, A Guide to K-12 Program Development (State of Connecticut: State Board of Education , *2002)* .

2 *The Arts, A Guide to K-12 Program Development* (State of Connecticut, State Board of Education , *2002)* 7.

3 Paraphrased from Lauren Resnick and Leopold E. Klopfer, *Toward the Thinking Curriculum* (Association for Supervision and Curriculum Development, 1989).

4 Paraphrased from Elliot W. Eisner, *The Arts and the Creation of the Mind* (New Haven: Yale, 2002).

5 Paraphrased from Al Hurwitz and Michael Day, *Children and Their Art: Methods for the Elementary School 6th* (New York: Harcourt, 1995).

6 Paraphrased http://en.wikipedia.org/wiki/Brain

7 Paraphrased http://www.neuroskills.com/brain.shtml

8 http://www.webmd.com/hw/brain_nervous_system/tu6083.asp

9 Paraphrased http://www.webmd.com/hw/brain_nervous_system/tu6083.asp

10 http://electronics.howstuffworks.com/mri9.htm

11 http://www.radiologyinfo.org/content/petomography.htm

12 Ruth Dowling Bruun M.D. and Bertel Bruun M.D. *The Human Body: Your Body and How it Works* (New York: Random House, 1992) 76.

13 Badders, William and et al. Discovery Works. (Boston: Houghton Mifflin, 2000).

14 Paraphrased from Foresman, Scott. *You and Your Health.* Illinois: Scott Foresman and Company, 1977.

15 Ruth Dowling Bruun M.D. and Bertel Bruun M.D. *The Human Body: Your Body and How it Works* (New Your: Random House, 1992).

16 Paraphrased: http://www.tpt.org/newtons/11/tstesmll.html

Teacher Reading List

Dowling Bruun, M.D., Ruth and Bruun M.D., Bertel. *The Human Body: Your Body and How it Works* . New York: Random House, 1992.

Presents accurate and easy to understand facts of all areas of the human body. Diagrams are displayed on each page to help describe the material.

Eisner, Elliot W. *The Arts and the Creation of the Mind* . New Haven: Yale, 2002.

Describes the importance of using the arts in education.

Foresman, Scott. *You and Your Health.* Illinois: Scott Foresman and Company, 1977.

A former school textbook can be referred to clarify topics pertaining to the human body.

Gelineau, R. P. *Integrating Arts Across the Elementary School Curriculum.* Belmont: Wadsworth Thomson Learning, 2004.

A guide describing how to integrate the arts to the everyday education classroom to enhance knowledge of content to students.

Gupta M.D., Kapil. *Human Brain Coloring Workbook* . New York: Princeton Review, 1997.

A workbook that describes the brain's structure and function, including coloring activities to differentiate between the parts of the brain.

Hurwitz, Al and Day, Michael. *Children and their Art: Methods for the Elementary School 6th.* New York: Harcourt, 1995.

A resource for teachers on how to teach art to children.

Resnick, Lauren and Klopfer, Leopold E. *Toward the Thinking Curriculum.* Association for Supervision and Curriculum Development, 1989.

Research describing the benefits of art in the classroom.

State Board of Education. *The Arts, A Guide to K-12 Program Development* . State of Connecticut, 2002.

The State of Connecticut's K-12 arts curriculum.

Student Reading List

Brandenberg, Aliki. *My Five Senses* . New York: Harper Collins, 1989.

Raczka, Bob. *More Than Meets the Eye: Seeing Art with All Five Senses* . Millbook Press: Minneapolis, 2003.

Ruis, Maria, Parramon, J.M., and Puig, J.J. *The Five Senses: Smell* . Barrons: New York, 1985.

Internet Sites

http://www.art.com

A website developed to purchase art, but also can be used to search by name to view different pieces of art work.

http://www.brushwithscience.com/Winter2002work/WinterSenses2002.html#Anchor-Garden-49575

A personal artwork display entitled "Brush with Science" by artist Julie Newdoll.

http://cybermuse.gallery.ca/cybermuse/search/artwork_e.jsp?mkey=10398

CyberMuse is an art education research site where , *Attributed to The Five Senses* , 1580 – 1590 can be viewed.

http://darwin.iz.uj.edu.pl/iz/anatomy/jakub/grafika/o1b.html

Students can view a digital image of human olfactory receptor cells processed by an electron microscope to better understand the three dimensional structure of cells.

http://www.exploratorium.edu/snacks/blind_spot.html

An activity in which students can view their eye's blind spot.

http://faculty.washington.edu/chudler/image.html

A website listing the advantages and disadvantages of different medical imagines systems. Also contains an image of a PET Scan.

http://www.faqs.org/health/images/uchr_02_img0179.jpg

An adult head X-ray.

http://www.lpg.man.ac.uk/web_page/photomedicine/MRI_image.htm

An MRI image of a human brain.

http://www.mcescher.com

Through this site students and teachers can view the artistic work of MC Escher, including Regular Division of the Plane with Birds, Relativity, and Circle Limit IV.

http://www.mindful-art.com/logo%20brain%20-%20web.JPG

A pencil drawing entitled "Windows of the Mind" by Eugenia Algaze Garcia.

http://www.mnartists.org/work.do?rid=99761

Pictures of Brain Carroll's sculpture entitled "Reality Processor".

http://www.mogallery.net/senseoftouch.html

A display of artwork by Mohamed Hagelamin,including "Sense of Touch".

http://www.nei.nih.gov/health/eyediagram/index.asp

The National Eye Institute provides five scientific diagrams of the eye and an interactive version for students and teachers to explore the structure of the eye.

http://www.ob-ultrasound.net/images/cscan2.jpg

An ultrasound of an unborn fetus's head.

http://www.parhammedical.org/Parham/Illness/Brain%20Pressure.htm

A CT Scan of the brain.

http://www.pbs.org/wnet/brain/

An informative and interactive website for both students and teachers to learn more about the brains structure and function.

http://www.poyi.org/59/02

A photograph entitled "Sense of Touch" by Damon Winter.

http://www.sarahscottart.com/artwork/index.album?i=14

A personal artist's website displaying self created artwork including "Morning Coffee" which is mention in this unit.

http://www.schools.net.au/edu/lesson_ideas/optics/optics_actsht1_p1.html

This site provides interesting color blind tests and optical illusions that can be used for the section on vision.

http://www.sfn.org/baw/photos.cfm

A website to view the first place winner of the 2004 Brain Art Competition by Alexandra Person entitled, "Georgia O'Keefe's Mind in Bloom".

http://webvision.med.utah.edu/sretina.html

An image of a retina as seen through an ophthalmoscope can be seen at this site, as well as the other information pertaining to the anatomy of a retina.

http://www.wga.hu/frames-e.html?/html/b/bruegel/jan_e/2/5sense2.html

The Web Gallery of Art is a virtual museum and searchable database of European painting and sculpture from 12th to mid-19th centuries. The Sense of Sight by Jan Bruegel the Elder can be viewed here.