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Water... "Good To The Last Drop"

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Introduction

Water intake and output is the key to a healthy life. Middle school students frequently complain about having headaches, stomachaches, or feeling tired. When I hear them complain about those and/or other minor ailments, I immediately think the culprit behind those maladies is the lack of water in their bodies. When I ask them, “How much water have you drank today?” they answer with either an “I don’t know.” or a resounding “none.”

From a teaching standpoint and a personal health standpoint, it is imperative that students understand the importance of hydration levels needed to maintain a healthy, balanced, and functioning body. It is important to understand why water intake has to match water output in order to maintain water balance crucial to maintaining physiological functions properly at the cellular, tissue, and organ levels. Water’s main responsibilities are regulating body temperature, transporting vital nutrients to and from cellular structures, tissues, and organs, removing waste substances from cells, and transporting the waste material to appropriate systems for disposal. Overall the above structure and functioning of water is vital to maintaining a homeostatic state of being within the body.

My unit focuses on informing and motivating students to recognize the necessity of taking effective steps in controlling and minimizing the threats encompassing their overall health status. One of the early proactive tasks for them to undertake is to become conscientious in maintaining a healthy level of water intake. This unit will provide evidence to support the importance of water consumption as a means to sustain and ultimately enhance our health.

Background

Windmill Springs Elementary School has an enrollment of 584 students. Enrolled student percentages are broken down into the following groups: Asians 53%, Hispanics 40%, Caucasians 2%, and other ethnicities 5%. [1] A unit on water and the components needed to assure and maintain good health needs to be pertinent and

available to all family members including the students.

Windmill Springs Elementary School is one of twenty-one schools in the Franklin McKinley School District, a Title 1 district, located in the East Side of San Jose, CA. The Windmill Springs neighborhood is comprised of families that are generally: Asian and/or Hispanic; single parent households; families with gang affiliations; homes where English is not the native language nor is it spoken at home; grandparents and/or other guardians raising students (due to parental issues) and some middle-class families.

Windmill Springs is a K-8 campus where older students are role models and help the younger ones with their schoolwork. The water unit could be an avenue the students approach to teach younger students the importance of drinking water and keeping hydrated and how it aids to maintaining good health. Many siblings attend Windmill so families would also benefit from the information brought home.

A science unit taught on the importance of maintaining a state of hydration, recognizing the signs of not consuming enough water daily, and the health consequences it produces within the body would be brought home and practiced by all family members. Also information will be distributed along with video clips highlighting and alerting the students to the dangers, and diseases associated with contacting contaminated water sources. I raise this point because due to the high numbers of ethnic groups at the school, there is a strong possibility the students travel to foreign lands on their school vacations and encounter questionable sources of drinking water.

It is extremely important for students to take a critical look at how much water they consume on a daily basis. The ingested amount matters to the state of their health. The water level must be maintained at high enough levels within all systems of the body to ensure and maintain health. This unit also provides students with engineering capabilities to research and address a global health concern of not having enough potable water available to fulfill and sustain an appropriate level for health purposes.

Rationale

I want to stress topics that are of critical importance to areas of applied knowledge that all 21st century students need to possess. Problem solving, analytical writing, collaboration, communications and creativity all need to be incorporated into a well balanced practicum. Special Ed, ELL’s, ED (emotionally disturbed) students included and encouraged to participate with general education students throughout the unit. Those students are usually the populations that are overlooked in academic courses, yet they need to be as informed as all other students when it comes to critical matters facing our world.

I include a service-learning component in this curricular unit because the student population is so diverse with family roots in many countries. It is a real possibility they have to travel abroad for holidays and vacations. They visit relatives in Vietnam, China, the Philippines, or Mexico. Many of them stay in villages where clean water might not be readily available. Water contaminated with human, animal or industrial wastes products pose a greater threat of contracting waterborne illnesses due to the students limited exposure to the water their relatives use. Knowing about potential exposure risks will prepare them to be more careful when swimming or coming in contact with foreign waters.

In the service-learning component students are asked to either devise apparatuses to trap and collect

rainwater, create mechanisms to filter water, or to test and treat potentially contaminated water. When they return to foreign lands students can introduce their designs to their families with the hope it will deliver a cleaner and disease free way of obtaining usable water.

Objectives

My proposed unit is titled, “Good To The Last Drop”. The unit will address the key concepts necessary for students to practice a healthy paradigm of staying hydrated well after they leave school. The major objectives covered in the unit starts with designating an amount of water that is required daily for an ideal level of hydration. Explanations will be given as to how and why transport systems located in cells, tissues, and organs function to maintain hydration pressure and thus acquire equilibrium. The pH and acid / base balances focus on why conditions of acidosis and alkalosis (either metabolic or respiratory) present risks upsetting the natural state of homeostasis. Information will be dispersed through lessons indicating what happens when water levels throughout the body are out of balance (either too much or not enough). Video clips will introduce how the kidney functions to keep water levels satisfactory. Unbalanced levels of water within the kidneys initiate a “fluid “saving response, and try to stave off dehydration from occurring while exhibiting the serious effects dehydration can place on our bodies.

Components of health issues related to waterborne diseases are discussed. The purpose is to connect the students to information and technology available in recognizing transmission modes of diseases, and possible courses bacteria and/ or viruses follow in transmitting diseases.

My students are at the age where they have to learn how to take personal responsibility for their health. This unit will facilitate understanding on how to be proactive in avoiding health problems caused by water issues, however if contact becomes unavoidable, being able to recognize and successfully treat their problems will help them be open to teaching others to do the same.

Content Objectives

Drinking enough water everyday is one of the least conscious priorities that most people fulfill. The guidelines for the amount of water intake should be a half of ounce for every pound. So if you weigh 160 lb. your intake should be 80 ounces daily.[2] There is some controversy to this total daily amount within the medical community, however a number of researchers agree one should at the minimum drink 8 glasses daily. With the water content in our cellular structures being approximately 55-60% of total body weight[3] we need to pay attention to this fact and make ingesting adequate amounts of water much more of a priority. Water makes up the majority weight of all our organs, tissues, and cells. In our body, water is distributed between two main compartments – an intracellular one, and an extracellular one. The largest amount of water is contained in the intracellular domain - 65%. Extracellular compartments contain 35% water and a high percentage of that total finds solutions containing salts (such as Na, Mg, and K). [4]

Intracellular fluid is primarily water based, and moves within the cell. Intracellular water is moved through, around, and out of the cell by osmotic forces. Extracellular fluid is saline based, and is stored outside the cell among the interstitial areas surrounding the cell. It can also be found in intravascular areas, (within the blood vessels), and cavities surrounding structures. CSF, G.I., synovial, pleural, peritoneal, and pericardial fluids are examples of extracellular.[5]

The type, location, and composition of intracellular / extracellular fluids are mentioned here to inform the reader of their important relationships in distributing and attaining water balance in the body.

Transport Systems

Diffusion

There are three passive transport mechanisms that our body employs to transmit and maintain fluid levels throughout our body - diffusion, osmosis, and filtration. In diffusion molecules move from an area of high concentration to a lower concentration to establish balance. Diffusion will continue until the concentration of substances is equal throughout a cell or tissue space. A few factors that influence diffusion rates are temperature and size of molecules in the solute.[6] The higher the temperature of the solvent becomes, the quicker the rate of diffusion. The larger the molecules are, the slower the diffusion process happens.

Osmosis

Cells are made of water. Water is the solvent part of solutions that exists both inside and outside of the cell membrane. Osmosis is concerned with moving water in and out of two compartments that are separated by a semi-permeable membrane. Therefore, osmosis is an important driving force in moving water across the cell plasma membrane, which is semipermeable, and separates the intracellular and extracellular fluids. A solution will consist of water and solutes usually salts (Mg, Na, Ca, K). The water from a lower concentrated solution moves through a semipermeable membrane into a higher concentrated solution, in an attempt to balance the concentrations on both sides of the membrane. Osmotic pressure causes water and solute movement to go in opposite directions simultaneously with variation in solution concentration guiding the direction.[7] The transmission of solid matter will go in one direction while the water component will move in the other direction. This helps quicken equilibrium to occur on both sides of the cell membrane. The passage of water-soluble molecules, minerals etc. will move through the membrane with ease, while other solutes will be kept out.

Another example of how absorption occurs through osmotic exchanges can be found in the intestine. As water travels to the stomach the absorption rates there are quite weak so water can travel quickly to get to the intestines. The mucosal lining is covered with blood capillaries. The layer that separates the lining from the capillaries is .0030mm thick.[8] Osmotic forces take place here because the digested food remains in communication with the mucosal layer over a period of time. Water is primarily absorbed in the small intestine.[9] Water passes from the small intestine into the bloodstreams by way of the capillaries. The capillary wall is permeable and allows for the passage of water, nutrients, and toxins when released by the cell. Everything released by the structures especially the toxins are carried out and eliminated either by way of urination, or defecation.

Classification of aqueous solutions

Solutions can be classified as hypertonic, hypotonic, or isotonic. An isotonic solution has the same osmolarity

as the fluid inside human cells: therefore an isotonic solution will maintain fluid balance in and out of the cell. A hypertonic solution will pull fluid out of the cell and into the extracellular space. A hypotonic solution will pull fluid back into the cell.[10]

Hypertonic solution has a higher osmotic pressure than the isotonic solution. A hypotonic solution has a lower osmotic pressure than isotonic. The importance of knowing the osmotic pressure in solutions is the effect they will have on cells. A red blood cell has a normal shape and volume when placed in an isotonic solution. The pressure on the membrane is balanced on both sides. A red blood cell that is immersed in a high concentration or hypertonic saline solution has water flow out of the cell in an attempt to balance osmotic pressure. If too much water leaves the cell, it takes on a shrunken appearance. A red blood cell placed in a low concentration of saline, or hypotonic solution takes in water from the extracellular space through the membrane increasing pressure and expanding the size of the cell. In addition knowing how solutions affect cells will beneficial to a patient faced with a medical need for intravenous therapy.

Filtration

Filtration moves solutes and solvents by hydrostatic pressure. Hydrostatic pressure is the force exerted by the weight of the solution and will move the solution from a high-pressure area to a lower one. However if you increase the pressure on one side of the membrane, or the fluid as a whole you force more water through the membrane. If enough pressure is applied to the side with the solute then it can overcome the pressure differences across the pores and reverse them causing water to flow against its concentration gradient.[11]

pH Balance

The acid and alkaline levels of pH in your body is appraised on a scale from 1-14. A scale reading of one denotes an extremely high acidic state. A rating of fourteen labels it exceptionally basic. Pure water has a pH rating of 7. The pH of blood is carefully regulated in the body: a pH of blood test lower than 7 or above 7.8 has the potential to be fatal. When the pH scale of blood is lower than 7.35 this a medical condition called acidosis. Acidosis can have many causes, and can be either metabolic, or respiratory in nature. On the other end a pH of above 7.45 is said to be alkalosis. Our blood is made up of, and carries acid and bases. A medical state of alkalosis can either be caused by not having enough carbon dioxide (an acid in nature) in the blood or having too much base materials (bicarbonate etc.) blood levels. Alkalosis can also have either metabolic, or respiratory connections.[12] It can be treated successfully if caught early.

Acid and Base

An acidic solution contains excess hydrogen ions. Acids can be either weak or strong depending on their location on the pH scale. A reading close to 7 indicates a weak acid while a strong acid will have a marker between 0 and 4 on the pH scale. A base is classified as being a solution having an excess of OH- ions. The same holds true for bases as mentioned above (for acids). A weak base has a pH level close to 7. A strong base will register 10 – 14. Every liquid will most likely have either acid or base characteristics due to pH levels, which focus on bondings with either hydrogen ions (H+) or hydroxide ions (OH-). [13] The information on pH, acid /base readings from above paragraphs are cited to illustrate the seriousness of deficient water amounts and their effects on our bodies.

To maintain a stable pH reading of 7.40 – 7.45, a buffer is usually involved.

Buffers in a solution minimize the effects of acid or base additions by binding or discharging hydrogen ions in

response to concentration changes. They have the capabilities to provide a weak acid (proton donor) or a weak base (proton acceptor) and a salt of the acid or base to interact with the strong acid or base that was added to the solution. This process is termed the buffering effect.[14]

Chemistry - Electrolytes

Electrolytes are chemical compounds dissolved in body fluids. They contain small electrical charged particles (called ions). When electrolytes are added to pure water the solution will conduct an electrical charge. Electrolytes dissolved in water split apart and form electrical charges either positive or negative. The positively charged ion is called a cation. The negatively charge is called an anion.[15]

The following chart describes the important cations, and anions where they are found and what is their importance.

Electrolyte	Location	Function
Na+ Sodium	Higher Extracellular	Osmotic pressure Neuromuscular excitability
K+ Potassium	Higher Intracellular	Neuromuscular excitability
Ca++ Calcium	Higher Extracellular	Bones Clotting factor
Mg++ Magnesium	Higher Extracellular	Enzymes Systems
	Anions	
Cl^-	Higher Extracellular	Fluid balance Osmotic pressure
HCO_3^-	Higher Extracellular	Acid base balance
Proteinates	Higher Extracellular	Osmotic pressure Acid base balance

Water's impact on body systems

Water is a building material for cell structure and function. It provides a transportation system for nutrients to enter and exit the cell. It is responsible for chemical and metabolic reactions such as breaking down of food particles into proteins, carbohydrates and lipids.[16] Water is also classified as a lubricant taking the form of mucus. Mucus is 90% water and is required for many systems to function properly. The respiratory system relies on mucus to trap dust particles, allergens, and foreign pathogens along the entire airway preventing objects from entering the lungs. In the digestive tract mucus acts as a lubricant to have material move over membranes smoothly i.e. food moving through the esophagus. Mucus protects the stomach lining against the harsh ph of stomach acid.[17] Mucus lines the colon and small intestine protecting them against inflammation by breaking down harmful bacteria.[18]

Water is imperative for the optimum maintenance and control of body temperature. The hypothalamus is the thermo-regulator center within our body. The blood and skin and skin are also important in the regulating process. When the hypothalamus detects a rise in blood temperature it signals the smooth muscles and surrounding blood vessels to dilate so more blood flows to the body's periphery thus moving heat away. Extra

heat leaves the body through sweating. Water in the form of sweat will evaporate on the skin and cool the body down. When the skin and blood detect colder temperatures the hypothalamus sends neural signals to the smooth muscles and surrounding blood vessels to constrict and reduce blood flow. The hypothalamus also signals the endocrine glands to secrete hormones to speed up metabolism and conserve heat.[19]

A vital organ essential to the water input / output balance, the kidney, lies within the body just below the ribcage and in back of the abdomen. Everyone has two kidneys which are positioned on each side of, and attached to the aorta, and vena cava – the body's two largest blood vessels. The kidneys' are situated in a prime location where controlling fluid balance, regulating electrolyte balances, filtering waste out of the blood, and producing urine can be performed.[20]

Kidneys can detect blood volume from the pressure in the vessels. If low the kidneys signal enzymes and proteins to signal the hypothalamus and adrenal glands surrounding the blood vessels to reestablish blood volume. The kidneys also regulate salt levels and the elimination of urea from the blood. The water that is not reabsorbed by the body will be eliminated as urine.

Water is critical for the functioning and maintenance for all body systems. We unconsciously depend on all of our systems to be in synchronicity with each other. To maintain homeostasis water intake has to match water output. If there is a severe imbalance, dire consequences could emerge either from drinking too much, or not enough water. Dehydration and toxicity come to mind.

Effect of Dehydration

"Water, it does a body good!" Instead of using the trademark saying from the milk commercial, I modified the saying to introduce this segment of my unit. Water has many positive effects on our lives when we keep our level of intake constant. Water helps us think, is responsible for blood flow, and helps our muscles move. When everything is in synchronicity we have optimal health. Dehydration is a condition brought on by an insufficient level of water or salt in your body. For most of us we have a sensation of feeling thirsty, and drinking water will turn your deficit around. Sometimes the sensation gets ignored, and if it continues to be ignored the body will revert into backup mode. There is a belief that if you eat foods that contain a high water content (for example fruit), and feel that will satisfy your water and relieve hunger sensations at the same time, that is not what is occurring in the body at this time. Dehydration is still present and symptoms are not being relieved.

If the body can't draw water from external compartments it must secure them from internal sources. Extracellular fluid sets up an immediate response. Blood continues to supply organs which forces the fluid from the interstitial compartment to give up its' water. The interstitial fluid becomes thickened and no longer can guarantee a correct exchange between blood and cells.[21] The body continues to look for water and will draw liquid from the intracellular fluid. Once this happens the cells will shrink because of the hypertonic effect of water leaving the cell causing the shrinkage, and the condition becomes irreversible.

Dehydration can lead to the following complications: kidney failure, shock, heat related illnesses, heart failure, and electrolyte imbalances. Kidney failure occurs when the volume of fluid decreases in the intravascular space, and blood pressure drops. Blood flow to vital organs like the kidney decreases and brings the potential for failure.[22] Shock ensues when the blood loss overwhelms the body's ability to correct the problem. Blood flow along with oxygen is severely decreased, and cell, tissue and organs start to fail. Heat related illnesses are caused when the body tries to cool down by sweating a may bring on dehydration to the point that

muscles may go into spasms. If dehydration continues where sweat can no longer help, heat exhaustion or heat stroke will happen. Heart failure is brought on by the lack of blood flow to it causing it to fail. Electrolyte imbalances occur because important chemicals like sodium and potassium are lost through sweat. Potassium balance lost to sweating brings on muscle weakness, heart rhythm interruptions, and seizures. Sodium that is lost will damage the kidneys and potentially cause renal failure, bring on seizures, and cardiac problems.[23] It is important to stress the point that if you sense thirst do something about it right away and you will be able to avoid the aforementioned consequences.

Waterborne Diseases

The World Health Organization says diarrheal diseases remain a leading cause of illness and death in the developing world. Every year, about 2.2 million people die from diarrhea; 90% of these deaths are among children, mostly in developing countries.[24] Coming in contact with stagnant pools of water, or having to draw drinking water from rivers where human and animal waste are dumped freely is unconscionable to many, but a stark reality to people who depend on the rivers for survival. Poor water quality and appalling sanitation are the main culprits that draw and support bacteria, viruses, insects, and parasites that cause dreaded diseases like cholera, malaria, diarrhea, dysentery, typhoid and schistosomiasis.[25] Humid regions are prime hotbeds for microorganisms to colonize and run rampant. Another place that hosts parasites, and microorganisms along with toxic chemicals are the agricultural wells found on land that indigent people call home.

Diarrheal diseases are major causes of death to infants and young children in developing nations. The children contract diarrhea from tainted water and become dehydrated from the water loss that occurs with diarrhea, potentially leading to death.[26] Cholera, typhoid fever, and schistosomiasis are the main diseases in most indigenous areas. Insects are another threat to people. The insects develop in stagnant water ponds and acquire parasites like malaria, filaria, and trypanosomes that are waiting to infect ones who come in contact with them.

Most waterborne illnesses are preventable. Proper sanitation habits, hand washing, and treating contaminated water with bleach would reduce a sizable amount of deaths caused by them. Informing students of the potential hazards they face when traveling home will help them realize that they can become agents of health to their relatives and provide them with tools (their apparatuses) to improve their relatives health.

Service Learning

Service learning components are vital module to add to a curricular unit. They foster understanding of concepts on a deeper level. Students can finish a unit, study for the exam tied to that unit, and take the test. The next unit will start immediately after the test is taken. Three weeks later, while reviewing past units, I found recall from those units were considerably lacking. Service learning serves as an outlet for students to add to their knowledge bases. Knowledge of subject matter is somehow transformed from an abstract state into a more concrete foundation and comprehension becomes more solidified. One of the biggest advantages is the direct link to real life situations that service learning bestows on people.

In this unit students will be asked to keep an engineering notebook that will contain the information given to them throughout the unit. They will be designing, building, testing, and developing mechanisms that can either be used at their households, or going with them when they visit relatives.

Strategies

At the beginning of the unit students will journal how much water they drink on a daily basis. They also will be asked to list other food and beverages they think will add water to the total intake being consumed, and research the amount of fluid removed, classified, and processed as water contributing to the total daily intake level. The first weeks' lessons address the physiological fluid levels our bodies require, and how water contributes to fulfilling those needs. A starting point would most likely be citing amounts of water designated as contributing to intake requirements, the maintenance of intake / output levels from a health perspective, and discovering the progression ultimately leading to why we feel thirsty. Backwards mapping the entire process of water intake and output will aid in students awareness of how the body adapts and applies actions necessary for survival purposes. The quicker the students start applying the knowledge to their own lives the better their chances are of acquiring a healthier lifestyle.

In later weeks the global component of my unit is introduced and environmental health concerns related to drinking processed water, and usage of water procured from ground sources such as wells and aquifers. This is significant because of their traveling to impoverished areas of Mexico or Vietnam would find the students most likely ingesting water primarily from those resources. Another hazard would be the exposure to contaminated water sources by swimming in native rivers.

Students do not have to travel far away to be exposed to social / environmental health hazards. In middle school kids like to share food and drink with each other. They do not think about the risks to their health, or the health of the people they are sharing food or drink with. There looms a huge possibility to their being exposed to illnesses emanating from those encounters. Another danger that faced students and their families on a local standpoint this year was flooding. A dam south of San Jose had to release its' floodgates to avoid overflowing, and possibly collapsing. The large creek was just south of the spillway and was the conduit for the excessive amount of floodwater. For a distance of 15 plus miles everything in the creek's path became consumed including waste material from homeless encampments, car batteries, and other hazardous wastes. Being aware on how to seek clean water or make their own filtering systems for dirty water was something that was lacking in their lives. Students having to face those eminent dangers locally and abroad drove me to think about developing a design challenge to construct develop strategies and equipment that could easily be implemented and be of value when faced with obscure events happening.

An engineering project will be offered as the culminating activity and assessment piece. The students will design apparatuses that would trap rainwater, store the water collected, and test it for safety purposes. They would also learn to design, and construct water filters out of materials that were readily available and cost effective. By completing the service learning component of this unit two purposes will be accomplished. First they will have created a tool(s) for cleaning and securing clean water that could be easily constructed and utilized immediately if another flooding situation arose. Second, addressing the global component students will take their apparatuses along with the confidence and knowledge they possess on water issue and teach their relatives how to secure clean water for when they come to visit.

In adopting Common Core standards one major criterion is Project Based Learning melding with traditional curricula to facilitate a deeper knowledge and understanding of content. I know in my personal practice, Design Challenges have instilled in the students a means to assimilate specific theories and principles on a much deeper level, and be of value to them in later years. In my research I found means and techniques to teach this unit on a much different, more defined mode in order to accommodate individual learning styles. In

doing so I can address the NGSS standards with fidelity.

Activities

Guiding Questions

Initially the unit will start with guiding questions. The questions are designed to access prior knowledge on health issues, extracting ideas on how students will demonstrate and practice critical thinking skills linking information with practical applications within the constraints of their project, and how they are going to become a member of a bigger 'family' than their own. At the beginning of each lesson the students will have the guiding questions to answer as journal entries.

As time goes on students will revisit earlier questions and develop new questions themselves.

Two primary questions that I want to pose at the very beginning of the unit are:

1. What impact does your eating, and drinking habits have on your health?
2. How are you going to acclimate your new knowledge to insure success?

In addition to the curricular readings, discussions, journaling, and presentations students will be visiting websites for information that will lead them to successfully interweave technology with engineering practices. Time will be given to the teams for collaboration purposes. In doing so they will be asked to perform design challenges that will devise clean water filters, create model aquifers, and / or manufacture ways to harvest rainwater. By doing so they have the skills to take their apparatuses and share with family members when they travel abroad.

Lessons

Osmosis and Diffusion

Guiding Questions

1. How do cell structures differentiate between osmosis and diffusion*?*
2. How do organisms interact with surroundings to obtain matter and energy?

Students will pair up and chart their existing knowledge of cell structures and functions. They will join with another team to compare and contrasts their statements.

Many lessons are available in the public domain for teaching osmosis and diffusion. The most popular ones are the "eggsperiment", and the gummy bears demonstration. Both utilize easy props for students to grasp the concepts of swelling, and shrinking (experienced by the egg or gummy bear) occurring when solutions of water, and material move through a semipermeable membrane.

One of the demonstrations involves potatoes. The demonstration is relatively inexpensive, and can be done at home. It involves a potato cut in half with each half carefully placed in to a separate container filled with water. The students are asked to label both containers - one as A, the other one B. The container marked A contains plain water. The container marked B is a solution with salt added to it. The size of the containers will determine how much salt needs to be added (usually two tablespoons are enough). Students will be asked to write their hypothesis in their notebooks. Students will come back either at the end of the day or the next morning and observe the potatoes. The potato in plain water might be a little colored, and will be a little dense. The potato in salt water will turn brown and shrivel. Students will then note their findings and see if their hypothesis matched their findings. An extension would be to come up with other situations in which osmosis and diffusion could be witnessed in a real life setting. An assessment could be the team of two drawing, and labeling containers depicting osmosis and diffusion reactions and then write their conclusion based on their drawings citing evidence to support their findings.

Dehydration

Guided Questions

1. How do structure and function within a system function contribute to a positive environment?
2. How do structure and function within a system potentially harm its' well being?

The students will pair up and brainstorm what dehydration looks like, feels like, tastes like, and smells like – I added that category because bad breath is a frequent indicator of dehydration. In doing so they will have a foundation for an inquiry research project. They will develop and base their questions on materials gained from web searches, and library usage. Posters will be constructed on material and information obtained from their endeavors. The student are going to use the posters to generate "public service announcements" and visit classrooms on campus to deliver their message or proper hydration and the ill effects of dehydration.

There is also an excellent website with interactive available. Go to www.nasa.gov and type in hydration station. This site has a free access rating for material and lessons.

Design Challenge

Guided Questions

1. How might someone acquire clean water from foreign surroundings?
2. How might someone be able to differentiate various water samples using pH strips?

Constraints

The design challenge begins with students individually researching the properties of drinking water, coming up with their own definition for it. They need to use their working knowledge of pH levels from prior lessons to test and decide the pH of water they would drink. They will also have some samples of water to be able to test pH levels and record the data. Students also will use technology to find various filtering materials – cheesecloth, coffee filters, charcoal etc. When finished they will be assigned a team, given a challenge packet with instructions, rubrics and specifications.

Students will be assigned in teams of 3-4 depending on class size. I use heterogeneous group settings, pairing below basic students with basic and proficient ones. The students are asked to research first, design a prototype following set guidelines, and then submit for approval.

When working in a design challenge where there are tools involved, I will take a class period to go over safety mechanics with the class. They are instructed safety is the first priority, and accidents rarely are accidents due to students fooling around. After the safety lesson they are given a short quiz to make sure they understood the material.

I base my constraints on tool usage, materials supplied, materials they bring from home, and time allotments – usually 7-10 days. Design challenges are used as culminating events to the concepts I am teaching.

Students will choose to either devise rain gutters to trap water and storage units to keep the water available to use at a later date, or invent water-filtering apparatuses they can utilize at home or abroad. They will research water websites looking for information about obtaining and testing materials that would achieve their goal. In addition they will be required to search engineering sites for ideas on how to construct a sustainable prototypes. In both challenges STEM principles and standards will be taught.

An extremely well written lesson(s) available now are obtained from the following website: www.jpl.nasa.gov/edu concerning astronauts and their ability to recycle potable water. I will probably use some of its' information in my own design challenge.

Resources

Student

Books

Emoto Masur. The Secret of Water. New York: Atria Books, 2006

Mulder, Michelle. Every last drop: bringing clean water home. Victoria, BC, Canada: Orca Book Publishers, 2014.

Nichols, Wallace J. Blue mind: how water makes you happier, more connected and better at what you do. London: Little, Brown and Company, 2014.

Websites

www.drinking-water.org

www.epa.gov.learn/kids/drinkingwater

www.geology.com "Water Activities"

www.jpl.nasa.gov

Teacher

Books

Batmanghelidj, F. Your body's many cries for water:

Burgan, Michael. Not a drop to drink: water for a thirsty world.

Nichols, Wallace J. Blue mind: how water makes you happier, more connected and better at what you do.

Vasey, Christopher. The water prescription: for health, vitality, and rejuvenation.

Websites

www.borgenproject.org "Prevention of Waterborne Diseases"

www.biology-online.org "What is Concentration Gradient"?

www.elsevier.com "Back to Basics in Physiology"

www.eschooltoday "Water Information for Kids

www.nationalgeographic.com "Water Pollution"

www.teach-nology.com

www.projectwet.org "Hydration"

www.rightdiagnosis.com

www.sciencing.com "Effects of Water Pollution"

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