**Q405 Saturday Science Teaching – Fall 2016**

**Lesson Plan One**

**Medical Engineering**

**Prosthetic Limbs**

**6th-8th Grade**

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

Learning Objectives:

* Students will be able to create prosthetic arms using everyday materials.
* Students will be able to demonstrate the process, necessity, and function of bending in fingers and joints.

Criteria:

* Students create a prosthetic limb that includes bends for joints, is functional for it’s purpose, and is stable (will not fall apart if moved).
* Students’ prosthetics have joints and the students test these joints through picking up objects.

B) STANDARDS:

● ***Science and Engineering Process Standards:***

* SEPS.2 Developing and using models and tools. Science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems.

● ***Content Standards:***

* 6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.
* 6-8.E.2 Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.
* 8.LS.4 Differentiate between and provide examples of acquired and genetically inherited traits.

C) MATERIALS (**asterisk (\*)** = any materials that may be a **safety concern**)

* Mill materials (Laser printer wood)\*---- Work with someone trained in using this
* Variety of the following:
  + Duct tape (3-5 Rolls)
  + Glue (4 bottles)
  + Cardboard pipes (long paper towel rolls) (5-10 rolls)
  + Plastic PVC pipes (5-10)
  + thick string ( 3 spools)
  + Small boxes (3-5)
  + Sponge (5-7)
  + Felt (5 large squares)
  + Straws (50)
  + Tennis balls (5)
  + Ping pong balls (5)
  + Beachball (5)
  + Large paper or strip to write focus question on (1)
  + Construction paper (30)
  + Paper (30)
  + Coloring tools- markers (30)
  + Tin foil (2-3 rolls)
  + Thicker rubberbands (at least 50)
  + Cardboard (at least five feet worth)
  + Scissors (27 if possible)\*

D) TEACHER CONTENT KNOWLEDGE

* Knowledge of the process, function, and necessity in joints bending
  + The use of flexor tendons underneath the wrist allow for the movement of the fingers and allow for hands to grab objects and to move.
  + Without the use of joints bending, humans would have a harder time talking, bending, etc.
  + Joints allow for more precision (picking things up, fluid and stable movement)
* What is a prosthetic limb and how does it work
  + Prosthetic limbs are limbs made from materials such as plastic, titanium, steel, aluminum and other such material.
  + They function for both functional purposes, such as walking, grasping, and movement, but for aesthetic purposes too (Those who get prosthetic eyes, ears, and other such prosthetics).
* Genetic vs. Acquired traits resulting in use of prosthetics
  + Prosthetics are in the market for those who have the need for them. This includes people who have survived accidents such as maiming, or limbs being infected, as well as those who were born without limbs such as people who have genetic diseases or disabilities such as Tetra-amelia

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

* <https://www.teachengineering.org/activities/view/cub_biomed_lesson01_activity>
* <http://armdynamics.com/pages/prosthetics-for-children>
* <http://www.handchallenge.com/assembling.html>
* <http://hortonsoandp.com/custom-limbs-how-are-prosthetics-made/>
* <http://science.howstuffworks.com/prosthetic-limb3.htm>
* <http://patch.com/wisconsin/menomoneefalls/cardboard-string-rubber-bands-and-prosthetic-hands>
* http://noelhenley.com/532/motion-of-the-fingers-thumb-and-wrist-language-of-hand-and-arm-surgery-series/

F) TENTATIVE TIMELINE:

9:15-9:20am –Students arrive in the classroom

9:20-10am—Begin the engagement activity

And explain the instructions for the lesson. (Mikaylah lead—others help)

10:00-11am— “Expore” Students work on prosthetics (Each person takes one group)

11-11:15am—Snack

11:15-11:45am—Testing prosthetics/ explain section (Each person helps their group)

11:45am-12pm—Share results, elaborating activity, clean up (All help clean, Mikaylah lead)

G) DESCRIPTION OF YOUR LESSON

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| --- |
| **ENGAGE (20 min.)**  (Before students arrive have various sized balls across the room) To begin the day, the teacher will start an icebreaker activity:  Activity (10 minutes):   * “I want everyone to walk around the room (few seconds pass) * Which is better? Dogs or cats? Dogs to the right and cats to the left   + Country or city?   + Peanut butter or jelly * Everyone get into groups based on eye color   + Everyone get into groups based shoe type   + Everyone get into groups based on favorite animal   + Now everyone quickly get into a groups of five * Everyone remember this group! (Assign numbers and teachers to each group)   The teacher will then direct the students’ attention towards the balls around the room. Ask the students to try and pick up the object without using their hands and bring it back to the group.   * Give students a few minutes to attempt to pick up their objects. * Ask students:   + “Are you having a hard time picking up the object without your hands?”   + “Now try to use to walk around the room without bending your knees!”   + “Lastly, try to walk around the room using only one leg”     - Demonstrate this by bending one leg back.     - Gear up: Try moving around without both legs   Engage students in a discussion about this activity:   * “Which was hardest, not having the use of your hands, your knees, or one of your legs?” * “How would you relate this activity to someone’s actual life?”   + Lead discussion into prosthetics     - Talk about acquired vs. genetic reasons for prosthetics       * Give specifics: accident vs. Tetra-amelia     - Types of prosthetics (Arm, hand, foot, legs, etc).     - What about the hand makes it easy to pick up things?     - How might this be seen in prosthetics people use? * “In knowing all of this, what makes a functional prosthetic? Today we are going to be figuring this out”   + Write on board or if on paper, hang up the focus question.   Focus Question: What makes a functional prosthetic? |
| **EXPLORE (10 min. For discussion 1 hour for building)**  To begin the explore section we will have the students get into their groups and do a “think-pair-share” they will discuss what makes a good prosthetic for an arm. They will then draw what one might look like. Ask the student’s questions to make them think about tendons, strength, bones, etc. Show the class drawings that meet learning goals.  Write on the board to share ideas  After this, students will individually create a blueprint for a prosthetic arm using a paper cut out hand, straws, and strings. Students will then discuss what each part represents. After discussing the drawings we will inform students that today they will be creating a prosthetic limb. “Later, we will test the limbs you created in order to see which groups created the most functional limb”.  Instructions:   * Each group is responsible for creating an arm.There will be 5 groups of 5 (have students return to the groups that they had in the icebreaker activity). * Remind students to think about the focus questions, “What makes a functional prosthetic?” * Students will self test prosthetic to meet qualifications list, and then by voting, there will be a competition to see which group created the best prosthetic.   + The students will come together to “Showcase”/Sell their prosthetic   + They, along with the teachers, will vote on the best prosthetic using the list below   + The teachers will be the final decision makers   Qualifications list:   * Prosthetic is made from everyday materials * Prosthetic is functional   + They support weight on them   + They are able to do their job (hands can pick up objects and bend)   + They are stable (They will not fall apart easily)   Competition list:   * Arms:   + Able to pick up the most objects the quickest (one ping pong ball, one tennis ball, one beach ball)   + Able to pick up and hold the most weight   + Aesthetic Factor |
| **EXPLAIN (30 min)**  The winner of the competition will explain their prosthetic and why they believe that they have a functional prosthetic. We will then talk about what makes a good prosthetic. We will ask them to think back on their own prosthetics, ones they have seen, as well as the exercises that they did in the engage section. We will discuss what aspects of a prosthetic make them functional, useful, and helpful. We will go back to the focus question and then write the answer on the board/paper. We will then watch a video about kids using prosthetics in sports and everyday life.  Video: <http://armdynamics.com/pages/prosthetics-for-children> |
| **ELABORATION**  After watching the students play sports with their prosthetics, think about how prosthetics change to meet the needs of the user.  Ending: Think of a specific leg that would be useful for swimming as opposed to walking?  Which prosthetic that was created today would win if this was based on swimming? What about running? Which materials would be best used for each? |

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th “E”)

* Exit slip
  + Ask focus question and provide a few lines for them to write what an efficient prosthetic looks like.
* Revising limbs if they are not good enough
  + Self-reflection through hypothesis and testing.
* Teacher questions throughout lesson
  + Why do you think this material would work better than this one?
  + What aspects of a leg are important when creating a prosthetic?
  + Which activities could this prosthetic work for?

I) GEARING UP/GEARING DOWN

**1. Gearing up:**

-Revise

Rather than just focusing on joints, try to add a tendon to the arm already created. Students who are really understanding what is going on completely the activities quickly, challenge them to trying to recreate a tendon.

* Using a website to create a prosthetic at the end. The website uses material such as platinum and gold. In the program, the students have to create the best prosthetic for an olympic runner.
* If another gearing up is needed, challenge the students to create another limb of their choice.

**2. Gearing down:**

* Simplify materials
* Scaffold more by demonstrating and having class discussions about how to start building a prosthetics
* Show elaborate video during snack if time does not permit

**Q405 Saturday Science Teaching – Fall 2016**

**Lesson Plan Two**

**Medical Engineering**

**Bones, Bones, Bones!**

**6th-8th grade**

**Alexa Halsted, Logan Riddle, Kim Foster, Ali Hill, Mikaylah Hershberger**

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

Learning Objectives:

* Students will be able to create splints and casts to aid in stabilizing and repairing broken limbs.
* Students will be able to explain the difference between stress and impact fractures.

Criteria:

* Students will break chicken bones in order to see how much weight it takes to break these bones.
* Students will create a splint or cast in order to repair the broken bone.
* Students’ repaired bones will be tested to see if they can hold the same weight/force it took the break the original bone.

B) STANDARDS (see<http://www.doe.in.gov/sites/default/files/standards/indiana-sixth-grade-standards-2016-41116.pdf>

● ***Science and Engineering Process Standards:***

* SEPS.2 Developing and using models and tools. Science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems.
* SEPS.3 Constructing and performing investigations. Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution.

● ***Content Standards:***

* 6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.
* 6-8.E.2 Evaluate competing design solutions using a systematic process to identify how well they meet the criteria and constraints of the problem.
* 6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

C) MATERIALS (**asterisk (\*)** = any materials that may be a **safety concern**)

* 20-30 chicken bones\*
* 10 steel rods (~ 5 inches)\*
* 50 metal screws (25 half-inch long plus 25 one-inch long)\*
* epoxy (enough for 30 drum sticks)
* 20 ~5 inch metal strips (already has screw holes in it)\*
* Mod Roc
* 24 ft of Nylon string
* two ring stand and clamps (5 sets if possible)\*
* Bucket of weights\*
* 27 Safety Goggles (these are in our classroom already)
* 5 rolls of Duct tape
* A box or regular Band Aids (for possible injuries)
* 5 Sticks (A vegetarian option)
* 30 Popsicle sticks
* 30 Paper clips
* 3 rolls of Medical Tape
* 5 smaller bowls to put water in
* Paper towels for cleaning water messes

**Safety Concerns:** The broken bones, steel rods, screws, and metal strips can be sharp. To address this safety concern, sandpaper has been used to dull down sharp edges. Furthermore, the Lead Teacher repeatedly informs the whole group that some materials are sharp and must be used with caution. Assistant Teachers are also working in each group and will help in any situation that a student does not feel confident in their own ability, and will be monitoring for safe and unsafe behavior. Additionally, the weights and clamps can be heavy when they fall over. To address this safety concern, experiments will be done on the ground so that nothing will fall on the student’s feet. Students will also be warned about being careful where they put their hands when putting the weights on. Students should never but any body part underneath the weights at any point.

D) TEACHER CONTENT KNOWLEDGE \*\*Be specific, be very detailed, know more than necessary

* Metric conversions between grams and kilograms. You need to move the decimal three times to the left. If you are converting from kilograms to grams, move the decimal three times to the right
* Types of stabilization:
  + Temporary types (external):
    - Splints: It also usually has a soft layer of cotton inside. A splint can be made from the same materials as a cast or may be a pre-made piece of stiff plastic or metal surrounded by strong fabric. It is like a half cast that's wrapped with an elastic bandage or held in place with Velcro straps. A splint is a good choice for a new injury when there is usually swelling. Like casts, splints should be kept dry. **Do not** remove your splint unless your doctor says it's OK. A basic rule of splinting is that the joint above and below the broken bone should be immobilized to protect the fracture site. For example, if the lower leg is broken, the splint should immobilize both the ankle and the knee.
    - Orthopedic Cast: There is a soft cotton layer of padding that rests against the skin and a hard outer layer that prevents the broken bone from moving. The outer layer is usually made of plaster or fiberglass. Fiberglass casts are made of fiberglass, which is a plastic that can be shaped. Fiberglass casts come in many different colors. These casts are lighter and stronger than plaster casts. Plaster casts are usually white and made from plaster of paris, which you may have used for school art projects. Plaster of paris is a heavy white powder. When it's mixed with water, it forms a thick paste that hardens quickly. Plaster is heavier than fiberglass.
  + Permanent types (internal):
    - Screws: Screws are used for internal fixation more often than any other type of implant. Although the screw is a simple device, there are different designs based on the type of fracture and how the screw will be used. Screws come in different sizes for use with bones of different sizes. Screws can be used alone to hold a fracture, as well as with plates, rods, or nails. After the bone heals, screws may be either left in place or removed.
    - Plates: Plates are like internal splints that hold the broken pieces of bone together. They are attached to the bone with screws. Plates may be left in place after healing is complete, or they may be removed (in select cases).
* Bone Marrow
  + Bone marrow is the spongy tissue inside some of the bones in the body, including the hip and thigh bones. Bone marrow contains immature cells, called stem cells.There are two types of bone marrow: red bone marrow (also known as myeloid tissue) and yellow bone marrow (fatty tissue).
* Types of fractures
  + Impact- The bone is broken immediately from the impact of an object or action.
  + Stress- Having a repeated weight added to a bone, causing the bone to break.
  + Compound- When the broke breaks through the skin.

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

* Repairing Broken Bones: <https://www.teachengineering.org/activities/view/cub_biomed_lesson10_activity1>
* Plaster Casts: <http://theimaginationtree.com/2014/01/diy-plaster-casts-doctor-role-play.html>
* Broken Bones Lesson: <https://educators.brainpop.com/bp-topic/broken-bones/>
* Bone Marrow: <http://www.medicalnewstoday.com/articles/285666.php>
* Splinting: <http://www.emedicinehealth.com/wilderness_splinting/article_em.htm>
* Temporary Stabalization: <http://kidshealth.org/en/kids/casts.html>
* Permanent stabalization: <http://orthoinfo.aaos.org/topic.cfm?topic=A00196>
* Bones Activity: <https://www.teachengineering.org/activities/view/cub_biomed_lesson01_activity2>

F) TENTATIVE TIMELINE

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| --- | --- | --- |
| Time: | Activity: | Teachers: |
| 9:15-9:30 | Students arrive in classroom | All teachers engaging with students |
| 9:30-10:00am | Begin the engagement activity and explain the instructions for the lesson. | Alexa: lead teacher doing lesson  Other teachers: additional facilitation and classroom management |
| 10:00-11:00 am | “Explore” students work on breaking the bones, tracking the amount of weight, and casting/splinting the bones | Each teacher works with a group of students |
| 11:00-11:15am | Snack  <https://www.youtube.com/watch?v=P5HwYWShBhw>  How bones heal  <https://www.youtube.com/watch?v=7nwCxVVzRd8>  First aid | All teachers engaging with students |
| 11:15-11:45am | Test the fixed bones strength and explain section | Each teacher has their own group of students |
| 11:45am-12:00 pm | Share results, elaborating activity, clean up | Alexa: lead end discussion  Other Teachers: facilitate discussion and classroom management  All: help clean |

G) DESCRIPTION OF YOUR LESSON

Focus Question: How do you repair a broken bone?

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| **ENGAGE (20 minutes)**  **Students will participate in an activity where they break pencils and crayons. They will discuss how they broke these different objects and class will have discussion on stress vs. impact fractures.**  Alexa:   * Welcome class. Re-introduce teachers. Have students line up from shortest to tallest. Count off students for four different groups. Have them each go to a table with a teacher and create team names. Write team names on the board. * *Can anyone tell me what you learned last week?* * *Today we will be continuing to work with limbs like we did last week. But this week, we will be focusing on a different, but important, part of our limbs. As someone said earlier, last week we talked a lot about joints and tendons. This week, we will be talking about something just as significant.*   **Teachers:**   * Place different material that the students will be breaking on their table. Each table will have 6 popsicle sticks and 6 crayons.   **Alexa:**   * *I want you to each take 1 popsicle stick and 1 crayon. Now, being careful of the people around you and your own self, I want you to break each of your materials. Try using different methods to break these bones; however, you are not allowed to use anything but yourself to break these materials, and throwing is not allowed.*   **Teachers:**   * Ask questions that make them think about the different ways bones can break (stress vs. impact) without using the terminology. * Ensure safe behaviour.   **Alexa:**   * *Can each group share how they broke their different materials? Which was harder? Did they break in the same places or different?* * Write down the answers students say on the board. * *Does anyone have any idea what the medical term for some of the ways we break bones are?* If no response, write Stress Fracture and Impact Fracture on the board. Inform students that stress is from repeated, prolonged injury over time and Impact happens suddenly. *Have students categorize the way they broke their bones into stress or impact fractures. Ask why they did so.* * *Today, we will be breaking bones (chicken bones), learning how strong they are, and understanding how our bones are breaking. And then, we will continue to be medical engineers and develop a way to repair these bones to see if they can withstand being broken again.* * ***IMPORTANT: We will be working with some sharp materials and some materials that you could get hurt with if you are not paying attention or using them appropriately. Be careful. If you do not feel comfortable handling something, ask your teacher and they will help you.*** |
| **EXPLORE (10 minutes for discussion, 1 hour for building)**  **As a group, students will attempt to break a chicken bone using weight and force if necessary. Students will then work on repairing their own individual chicken bone. When finished, students will discuss their repair design and they will choose the most effective design to fix the group bone.**  **Alexa:**   * Write focus question on the board “How do you repair a broken bone?”. * *Today, to repair our bones we will be putting casts on them and splinting them. Have any of you ever had either of those? Quickly share with your group.* * Allow a few minutes for discussion. * *From what you have discussed, experienced, and seen, what makes a good cast or splint?* Write down answers on the board (Strong, Minimally invasive, Compatible, Inexpensive, Ease of implementation). * *Similar to last week, when we are creating our design for repairing our bones, we want to be thinking of these words.* * *The first task your team has to do is to break this chicken bone. You will be provided with clamps to hold your bones, duct tape to secure your hold, string to hold your weights, and weights. You will also have a chart to keep track of the amount of weight you use. Here is an example of how you will set up.* * Show students how to set up experiment.   **Teachers:**   * Give each group their bone to be broken and help them safely and carefully set up their equipment. \*\*\*Vegetarian option available. * Work on the floor. * Provide them with the weights only first (give each group equal amounts of weights). If students put all weight and the bones haven’t broken, have discussion about stress vs. impact fractures. * Then allow them to hit the bone with one of the weights until it breaks. * Record how many hits it took.   **Alexa:**   * Have each group quickly discuss what they did to break the bone, how much weight it held, and what kind of fracture it was. * *Now you will each be getting your own already broken bone. There will be a variety of materials on your table that you can use to repair the bone - keep in mind the words we discussed earlier.* * ***And again, some of these materials may be sharp. Please be careful and ask a teacher if you need help.***   **Teachers:**   * Hold onto the duct tape. Only allow each student to have one small piece. * Ensure student safety throughout experiment. * Ask questions asking why they are using those materials, how it will help with their break, why it would be good for the person using it, how would they improve, etc.   **Alexa:**   * Once groups are finishing, have them discuss themselves which designs they think are the most stable, least invasive, etc. * Have students decide how they are going to fix the group broken bone and move ahead once group members agree. |
| **EXPLAIN (30 minutes)**  **Students will share to the class how they chose to repair their bones and then they will each take turns seeing if their bone can withstand the same amount of weight and force as it did before. We will discuss as a class the best ways to repair a bone.**   * Once all groups have finished repairing their group bone each group will take a turn to answer how they repaired their bone. * Each group will work to see if their repaired bone can withstand the same amount of weight and force it did before. * After the experiment, students will come back together, and talk about what happened. * Under each group’s name, write the general outcome. * Have students as a group come up with a one sentence statement to describe how to best repair a bone. * Each group will write their statement on the board and we will have a class discussion. |
| **ELABORATION**  **Students will watch a video on fixing bones using screws and rods placed into the human body.**   * Watch this video: <https://www.youtube.com/watch?v=GvNP9XsChwA>   **Alexa:**   * *Have you ever seen or heard of people using the materials that they used here?* * *What were some materials that you saw?* * *What is different about how these bones were repaired than what we did?* * *When do you think this would need to be done?* * *Explain why this would be a better or worse method of repairing for the bones we did today.* |

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th “E”)

* Exit slip
  + Pass out precut exit slip paper with question: If you had to repair a bone, thinking of all the materials we used and videos we watched today, how would you repair it?
* Tracking the amount of weight needed to break the bone.
  + Self-reflection through hypothesis and testing.
* Teacher questions throughout lesson
  + Why do you think this type of bone stabilization is better than the other?
  + How would this affect the patient?
  + Would this be cost effective?
  + How would you describe the difference between stress and impact fractures?
* Pre Embedded formative questions are written in blue

I) GEARING UP/GEARING DOWN

**1. Gearing up:**

* Assign monetary value to materials and give students a budget. The students have a specific budget on the amount of money they can spend on materials. They will “buy” these materials to use and repair their bones. Budgets will be monitored through student “checkbooks” that the teacher has.Students would be given $70 to work with.
  + Duct tape $50
  + Casting $25
  + Metal Sheet $10
  + Epoxy Glue $10
  + Nail $10
  + Popsicle stick $5
  + Medical Tape $2
  + Paper clips $2

**2. Gearing down:**

* Simple materials; only casting not splinting their individual bones.
* Scaffold more by demonstrating and having class discussions about how to begin casting a bone. They will do the group bone first and then their own bones.
* Partner students up rather than individual pairing of the bones.

**Q405 Saturday Science Teaching – Fall 2016**

**Lesson Plan Three**

**Medical Engineering**

**Pump! Pump! Pump it Up! (The Circulatory System)**

**6th-8th**

**Ali Hill, Mikaylah Hershberger, Alexa Halsted, Logan Riddle, Kim Foster**

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

Objectives:

* Students will be able to demonstrate how to the circulatory system functions in a healthy human being.
* Students will be able to explain what lifestyle choices (food, exercise, and habits) they can make to aid in a healthy circulatory system.

Criteria:

* Students will create their own circulatory system models in order to illustrate how the circulatory system functions.
* Students will push “blood flow” through the models they create to see how it flows through the heart, veins and arteries.

B) STANDARDS (see<http://www.doe.in.gov/standards/science>)

***Science and Engineering Process Standards:***

* SEPS.2 Developing and using models and tools. Science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems.
* SEPS.3 Constructing and performing investigations. Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution.

***Content Standards:***

* 7.LS.4 Research and describe the functions and relationships between various cell types, tissues, and organs in the immune system, circulatory system and digestive system of the human body.
* 6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.
* 6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

C) MATERIALS (**asterisk (\*)** = any materials that may be a **safety concern**)

* PVC pipes (at least 13, they will be cut in half)
* Little tubes (same ones used for the arms)
* Water
* Food dye (preferably red)
* clown balloons (long and thin, at least one package of these)
* straws (at least 12-13
* rubber bands (about 30)
* Duct tape (5 rolls)
* Water bottles (15- we are bringing these in)
* Q200 Posters for students to draw their people (15)
* Permanent markers (15 if possible)
* Scissors\*

**Safety Concerns:** Students may use scissors in order to puncture the tube to create holes for addition tubes. This could be dangerous because the students cut accidentally cut themselves if their fingers are in the way. In order to avoid this concern, teachers will warn students before they do this that they must be aware of the location of their hands as well as their peers. If the teachers notice any unsafe behavior, the can take the scissors away and let another student make the holes. Another option is the teacher cutting the holes themself.

D) TEACHER CONTENT KNOWLEDGE

* Circulatory System: The main function of this system is to deliver nutrients and oxygen to cells as well as take away carbon monoxide and other wastes.
* Blood Vessels: Blood vessels transport blood through the body through a variety of different body components, including the arteries, veins, and capillaries.
  + Veins: In most cases, veins transport deoxygenated blood from the body to the heart. The exception is the pulmonary veins; these veins take blood that is oxygenated from the lungs to the heart.
  + Arteries: In most cases, arteries transport oxygenated blood from the heart to the rest of the body. The exception is the pulmonary artery; this artery takes deoxygenated blood between the heart and the lungs.
  + Capillaries: These are the smallest blood vessels. The function of these vessels is to allow oxygen and nutrients into cells. Additionally, they also move waste from the cells to the bloodstream.
* Blood Composition:
  + Red blood cells: carries oxygen
  + White blood cells: part of immune system
  + Platelets: clots
  + Plasma: a variety of functions including maintaining blood pressure and body temperature.
* Heart: An organ that functions as a pump for blood throughout the body. It consists of four chambers and deoxygenated and oxygenated blood enters and exits.

Common Problems:

* Aneurysm: a weak spot in an artery that develops into a large bulge.
* Heart disease: a constriction of arteries that is from a lack of blood.
* High blood pressure: an abnormal increase in pressure in arteries.

Healthy Lifestyle Choices:

* Food: moderation is key, food pyramid (carbohydrates, fruit/ vegetables, dairy/ meat and protein), cut back on sugar, drink water
* Exercise: 150 minutes of moderate aerobic exercise per week (30 minutes, 5 days a week)
* Healthy Habits: getting enough sleep (8 hours a day), proper hygiene practices (showering, brushing teeth/hair, etc.), mental health, etc.

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

Ted Ed Video:

<https://www.youtube.com/watch?v=ruM4Xxhx32U>

Circulatory system function:

<http://www.livescience.com/22486-circulatory-system.html>

Circulatory system overview with different parts:

<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/circulatory-system>

Different body systems:

<http://bio100.class.uic.edu/lecturesf04am/lect20.htm>

Exercise recommendation:

<http://www.mayoclinic.org/healthy-lifestyle/fitness/expert-answers/exercise/faq-20057916>

Healthy Eating:

<http://www.helpguide.org/articles/healthy-eating/healthy-eating.htm>

Blood Vessel:

<https://www.sciencedaily.com/terms/blood_vessel.htm>

Healthy Habits:

<http://www.momjunction.com/articles/healthy-habits-teach-kids_002855/#gref>

Plasma:

<http://www.nhs.uk/conditions/plasma-products/Pages/Definition.aspx>

Heart function:

<http://www.livescience.com/34655-human-heart.html>

Aneurysm:

<http://www.healthline.com/health/aneurysm>

High blood Pressure:

<https://www.heart.org/idc/groups/heart-public/@wcm/@hcm/documents/downloadable/ucm_300310.pdf>

F) TENTATIVE TIMELINE

|  |  |  |
| --- | --- | --- |
| Time: | Activity: | Teachers: |
| 9:15-9:30 | Students arrive in classroom | All teachers engaging with students |
| 9:30-10:00am | Begin the engagement activity and explain the instructions for the lesson.  Show the students the Ted Ed video  <https://www.youtube.com/watch?v=ruM4Xxhx32U> | Ali: lead teacher doing lesson  Other teachers: additional facilitation and classroom management |
| 10:00-11:00 am | “Explore” students work on creating their own circulatory system models. | Each teacher works with a group of students |
| 11:00-11:15am | Snack:  Show the students the Bill Nye video about blood and circulation  <https://youtu.be/-Cx6O_c5jN4> | All teachers engaging with students. |
| 11:15-11:45 | Explain- students share their designs to the rest of the class. | Each teacher has their own group of students |
| 11:45am-12:00 pm | Share results, elaborating activity, clean up | Ali: lead end discussion  Other Teachers: facilitate discussion and classroom management  All: help clean |

G) DESCRIPTION OF YOUR LESSON

|  |
| --- |
| **ENGAGE**  **Ted Ed Video**  **PowerPoint of Healthy/Bad food choices, and exercises**  Ali:   * Welcome class. Re-introduce teachers if necessary. * *Can anyone summarize for me what we have learned about so far in Saturday Science?* * Have the students line up starting at one side of the room and ending at the other side of the room. The students will then be given an object to transport from the beginning of their line to the end of their line. * *Can anyone explain why this worked so easily?* * Then take out three or four students from random spots and have the students try this again. * *Can anyone explain why this didn’t work as easily?* * Have the students look around the room and find one or two people they have never worked with before and go stand by those people. * *This morning we are going to move away from external parts of our body like limbs, joints, and tendons and focus on internal parts of our body.*   Teachers:   * Get the students settled down and sitting with their partners so that they are now ready to watch the video of the circulatory system from TedEd. (Show TedEd video). <https://www.youtube.com/watch?v=ruM4Xxhx32U> * *“What could be some complications to the circulatory system working properly?”*   Ali:   * *Now that we have watched this video and saw how the circulatory system works, we are going to look through this PowerPoint and see what food choices are good for/bad for our circulatory systems, and what exercises can be used to keep us healthy.* (Show the PowerPoint). *You and your partner are going to think of creative way to make a model version of the circulatory system. With your partners think of ways you can create your circulatory system with the materials that are provided.* (Show the students the materials so they know what they are working with). * *“What makes the blood flow throughout the body?” “What would happen to the blood in our body if the heart wasn’t working properly?”*   Teachers:   * Get each of their groups the materials they will need. Walk around between the different groups and ask students questions about how they are going to create a functional circulatory system with the materials they are given. Ask them questions about what they think certain pieces of materials may represent in their circulatory systems.   Ali:   * *We have watched the video, we know how the circulatory system functions, you have had time to brainstorm ideas for your model circulatory system now let’s begin constructing your plans.* |
| **EXPLORE**  **Create circulatory system**  **\*Caution: When using the scissors to make holes in the tubes, inform the students to be careful and use with caution.**  Ali:   * Write the focus question on the board: “What makes a functional circulatory system?” * *Who can give me an example of what it takes to have a functional circulatory system? Write down examples on the board (blood flow, veins, arteries, heart).* * *Just like we have done for the past two weeks we are going to keep these key ideas in our mind as we are making our models.* * Students can begin to create their models. * ***Remember if you decide to use scissors to cut any of your materials make sure you raise your hand and have a teacher present before you begin.***   Teachers:   * Move around between the different groups helping the students if they are seen using the scissors. Make sure they are being serious and not joking around. * Ask students questions about why they chose certain materials, and what those materials represent in their models. “*What would model the heart?”*   Ali:   * Encourage students to test their models as they are working. *If you notice something isn’t working, you can change what you have done to make it better. Discuss with your partners what you need to change, why will this change help make a more functioning circulatory system?* * Once all revisions have been made and the students are finished with their models, we will begin sharing the different designs students made and why they think their model represents a functioning circulatory system. |
| **EXPLAIN**  **Students will share their designs with the rest of the class, explaining what their materials represents and why their model represents a functioning circulatory system.**   * Once every group has finished we will clean up our work areas and prepare for demonstrations. * Each group will demonstrate how their model works. * After each group has shared their models, we will have a whole-class discussion on which group came up with the most functional system and explain why it’s the most functional. |
| **ELABORATION**  **Students will discuss what they can do in their everyday lives to make healthier life choices.**  Ali:   * *After completing this activity, watching a couple of videos, and looking through our PowerPoint, what types of changes do you think you could make in your life to ensure that you have a healthy functioning circulatory system?* * *“What would make your circulatory system the most healthy?” Let’s turn it around, what would make your system the least healthy?* |

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th “E”)

* Asking questions throughout
  + “What would model the heart?”
  + “What could be some complications to the circulatory system working properly?”
  + “What would make your circulatory system the most healthy?”
  + “What makes the blood flow throughout the body?”
  + “What would happen to the blood in our body if the heart wasn’t working properly?”
* Pre Embedded formative questions are written in blue

I) GEARING UP/GEARING DOWN

**1. Gearing up:**

* The students will creating a more realistic heart in that it opens and closes properly. (Include all parts of the heart)
* Students will be able to add more aspects of the circulatory system such as demonstrating how oxygen is carried throughout the body.

**2. Gearing down:**

* The students will create a smaller version of the circulatory system.
* Students will have a less complex version of the circulatory system.
* Students will see a model of create a circulatory system.
  + Show the students the model of the circulatory system that we created it. This will give them an idea on how to create their own models.

**Q405 Saturday Science Teaching – Fall 2016**

**Lesson Plan Four**

**Medical Engineering**

**My 5 Senses**

**6th -8th grade**

**Alexa Halsted, Logan Riddle, Kim Foster, Ali Hill, Mikaylah Hershberger**

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

Learning Objectives:

* Students will be able to analyze how the nervous system affects the five senses.
* Students will be able to recognize obstructions to the senses and creatively think of ways to fix those problems.

Criteria:

* Students will do activities to explore the purpose of the senses.
* Students will do activities with an “impaired” sense and contemplate how an impaired sense affects the daily life.
* Students will brainstorm ideas that can repair the senses and making the completion of daily tasks easier.

B) STANDARDS (see<http://www.doe.in.gov/standards/science>)

● ***Science and Engineering Process Standards:***

* SEPS.1 Posing questions (for science) and defining problems (for engineering). Engineering questions clarify problems to determine criteria for possible solutions and identify constraints to solve problems about the designed world.
* SEPS.2 Developing and using models and tools. Science and engineering is to identify and correctly use tools to construct, obtain, and evaluate questions and problems.
* SEPS.3 Constructing and performing investigations. Scientists and engineers are constructing and performing investigations in the field or laboratory, working collaboratively as well as individually. Researching analogous problems in order to gain insight into possible solutions allows them to make conjectures about the form and meaning of the solution.

● ***Content Standards:***

* *6-8.E.1 Identify the criteria and constraints of a design to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.*
* *6-8.E.3 Analyze data from investigations to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.*
* *6-8.E.4 Develop a prototype to generate data for repeated investigations and modify a proposed object, tool, or process such that an optimal design can be achieved.*

C) MATERIALS (**asterisk (\*)** = any materials that may be a **safety concern**)

* Small puzzle (40 or less pieces)
* 5 fabrics of different texture (soft, rough, itchy, etc.)
* 4 bananas thinly sliced
* Box of toothpicks
* Recorder with sounds +
* Sunglasses with glue on outside of lens+
* m&ms (4 packages)
* blueberries (one handful)
* Blindfolds +
* Box of tissues
* Box of saltine crackers
* Skittles (1 package)
* 2 pairs of gardening gloves (thick)

+I can provide the recorder with sounds, sunglasses with glue, blindfolds

D) TEACHER CONTENT KNOWLEDGE

* Permanent vs. Non permanent nervous system impairments.
  + Permanent: Impairment to the nervous system in which the impairment cannot be fixed
    - Ex: loss of ability to walk, complete loss of eyesight,
  + Non-permanent: impairment to the nervous system in which the impairment can be fixed or helped
    - Ex: loss of hearing (cochlear implant, hearing aid), degrading eyesight (contact lenses, glasses)
* Teacher will have to know the 5 senses and the organs that control the sense:
  + Sensory Neurons
    - This is how the brain communicates with the body
  + Sight:
    - Eyes
    - Optical nerves: transfer electrical impulses of visual information to the brain
    - How vision is transferred to the brain and how things would be implicated in this transfer
    - Blindness
      * Color blindness (red/green)
      * Vision (contacts)
      * Partial blindness
      * Full blindness
  + Hearing:
    - Ears
    - Major parts of the ear + functions
      * Pinna: Ear flap (outer ear) to collect and transmit sound
      * Meatus: Ear canals that amplifies sound
      * Tympanic Membrane: Thin tissue that acts like a drum to make sound vibrate
      * Malleus, Incus, Stapes: parts of the middle ear that pass sound vibrations on
      * Cochlea: Filled with nerves that pick up vibrations. If the frequency is too high or low the nerve hair can break off. One of the biggest contributions to hearing loss.
      * Auditory Nerve: Turn vibrations into electrical pulse which is sent to brain.
      * Hairs in ears don’t grow back but in nose they do
    - Deafness
      * Partial and full deafness
      * Tone/pitch
  + Touch:
    - Skin
      * Nerves (how we feel things)
        + Nerve endings send signal to brain which indicates the appropriate reaction to the touch
      * Layers: Dermis/Epidermis
      * Largest organ
    - Dulled nerve endings/dead nerve
      * Frostbite, prosthetics phantom limb
  + Taste:
    - Tongue
      * Taste buds: Sweet, salty, sour, bitter, and savory taste receptors are located sporadically all around the tongue. Certain areas are slightly more sensitive to a certain taste.
    - Smell can affect taste- they are connected senses because the flavor of food can be affected by the food odor.
    - Blockage of olfactory system and receptors to the brain
  + Smell:
    - Nose
      * Olfactory system
        + Consists of bulbs and cortexes in brain
    - Major Parts of Nose + function
      * Nostrils
        + The “holes” in the nose
      * Septum
        + Made of thin pieces of bone
        + Wall that separates the nostrils from one another
      * Cartilage
        + flexible material that's firmer than skin or muscle
        + What septum is made of
      * Nasal cavity
        + Behind the nose
        + Middle of face
        + Connects with back of throat

separated from the inside of your mouth by the palate (roof of your mouth)

* + - Blockage of olfactory system and receptors to the brain
    - Causes: sinus infections, cold, air quality, nasal polyps, injury to the nose.
* Teacher will know devices that help correct impaired senses
  + Contact lenses/ glasses to correct impaired sight
  + Hearing aids (outside ear) to assist impaired hearing
  + Sonar stick/ white can to assist people who are blind
* Teacher will know devices that help repair impaired senses
  + Lasik Eye surgery repairs eyesight
  + Cochlear implants to repair impaired hearing
  + EnChroma: eyeglasses to help people who are color blind
  + Eye surgery to help people who are blind see

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

* 8 Stations/ Visual Impairment: <http://www.tsbvi.edu/instructional-resources/1912-visual-impairment-what-is-it-like>
* Impairment Activity Stations: h[ttp://healthytomorrow.sci-health.org/documents/Lesson%202%5B1%5D.%20Senses%20and%20Sensory%20Impairments.pdf](http://healthytomorrow.sci-health.org/documents/Lesson%202%5B1%5D.%20Senses%20and%20Sensory%20Impairments.pdf)
* Thoughts Worksheet:<https://www.pinterest.com/alannabnana/writingteaching-ideas/>
* Contacts vs. Glasses: <http://www.contactlenses.org/clsglasses.htm>
* Lasik: <https://en.wikipedia.org/wiki/LASIK>
* Cochlear Implants vs. Hearing Aids: <https://www.audicus.com/cochlear-implants-vs-hearing-aids/>
* EnChroma: <http://enchroma.com/>
* Sonar Sticks: <http://www.cnn.com/2014/06/20/tech/innovation/sonar-sticks-use-ultrasound-blind/>
* White Cane: <https://en.wikipedia.org/wiki/White_cane>
* Parts of the ear: <http://www.md-health.com/Parts-Of-The-Ears.html>
* Video about sense tricks: <https://www.youtube.com/watch?v=alubBa1s2G0>
* Taste buds: <http://www.iflscience.com/health-and-medicine/neat-and-tidy-map-tastes-tongue-you-learned-school-all-wrong/>
* Optic Nerve: <http://www.healthline.com/human-body-maps/optic-nerve>
* Parts of Nerves: <http://kidshealth.org/en/kids/nose.html>
* Olfactory System: <http://www.ablongman.com/html/psychplace_acts/olfaction/anatomy.html>

F) TENTATIVE TIMELINE

|  |  |  |
| --- | --- | --- |
| Time: | Activity: | Teachers: |
| 9:15-9:30 | Students arrive in classroom | All teachers engaging with students |
| 9:30-10:00am | Begin the engagement activity and explain the instructions for the lesson.  Quickly explain stations and 5 senses (Powerpoint) | Kim: lead teacher doing lesson  Other teachers: additional facilitation and classroom management along with monitoring a stations |
| 10:00-11:00 am | “Explore”  Students will experience the impairment of the senses and think of ideas they have seen to “fix” the senses. | Each teacher facilitates a station, while monitoring student discussion and discovery. |
| 11:00-11:15am | Snack  Show video about impaired senses  <https://www.youtube.com/watch?v=alubBa1s2G0>  <https://youtu.be/SyB4Igy1_xA> | All teachers engaging with students |
| 11:15-11:45am | Explain- students will discuss their experiences with the stations and their thoughts about each of the “impaired senses”. Students will collaborate and discuss methods and devices that can repair these broken senses. | Each teacher has their own group of students |
| 11:45am-12:00 pm | Share results, elaborating activity, clean up | Kim: lead end discussion  Other Teachers: facilitate discussion and classroom management  All: help clean |

G) DESCRIPTION OF YOUR LESSON

|  |
| --- |
| **ENGAGE**  **Discover uses of senses- stations**  Kim:   * Welcome class. Re-introduce teachers. * *Can anyone explain to me what they past weeks have consisted of?* * Show powerpoint and discuss the 5 senses with the class. * *Can anyone summarize the 5 senses for the class?* * *This morning we are going to take a step away from building and modeling medical engineering and we are going to experience our 5 senses and simulate an impairment to each sense.* * Teachers: Get students settled down in their groups so that they are ready to begin the “engage” stations. * Kim: Designate a group to a station and explain the rotation process.   Activity:  Students will begin by exploring their 5 senses with different stations dedicated to the senses. Each of the stations will allow students to explore the senses: touch, smell, taste, hearing, and sight. The “touch” station will include a puzzle for students to piece together and objects that are of different textures. Students will describe the different textures of the objects and relate those descriptions to things they have seen in their daily lives. The “smell” stations will have jars with different smells. Students are to smell the jars and describe the smell. They, again, are to relate the smells to things they have smelled before. The “taste” station will place a thin slice of banana between their lips and will not touch it with their tongue. They will realize they cannot taste the banana flavor. The students will, then, touch the banana with their tongue and recognize that the tongue is the organ used for taste. The “hearing” station will consist of a few recordings of sounds they should recognize. The students will keep track of the number of sounds they could correctly identify. Finally, the “sight” station will consist of students playing a short game of “I spy” with their group members. Each of these stations introduces the idea of the purpose of each of the senses. Teachers will monitor each station, but more specifically the smell, taste, and hearing station. This is so that safety is recognized and monitored closely. |
| **EXPLORE**  **Simulate impaired senses- stations**  Kim:   * Write focus question on the board: “What are some devices that can help impaired senses to be functional?” * *Who can give me an example of what an impaired sense might look like?* Write some examples on the board. * *Just like we have done for the past two weeks we are going to keep these key ideas in our mind as we are exploring the stations.* * Students will begin the stations.   Teachers:   * Monitor the stations and ask guiding questions. * *How was it different doing these activities with an impaired sense than it is without the impairment? Was it more difficult?* * *What are some ways people can accommodate the impairment to do daily activities?*   Activity:  Students will begin to explore how impairments to the senses affects tasks on a daily basis. This will consist of 2 parts: stations and a trust walk. The stations will be stations with each sense impaired in some way. There will be 5 stations- one for each sense. The “sight” station will consist of sunglasses with glue on the lenses to blur the sight. Students will be asked to sort m&m’s and blueberries into two piles. If that is too easy, then students will be asked to sort the m&m’s into their different colors. They will do this with the sunglasses on. Students will also have the option to use a blindfold to completely impair their sight. They will be asked to separate the blueberries from the m&m’s. The next station (“smell”) will try to smell the same smells from the engage activity, but this time with a tissue over their nose. Students will try to recognize the smells and see how many they could guess correctly. The “taste” station will each try to taste 3 different foods: m&m’s, bananas, and crackers. Students will plug their nose (helps to impair the sense of taste) and try each of the food items. They will note whether or not they can taste the food item. The “touch” station will try to pick up skittles with gardening gloves on. The students will then try again but without using their fingers. They will put the skittles into a paper cup. The final station will be the “hearing” station will require students to guess what object was dropped on the table. They will face away from the table and the teacher. First, the teacher will drop a blueberry. Then, they will drop a m&m, ping pong ball, and then a golf ball. Students will make note of which object was easiest to hear. Students will use a worksheet to make notes about their observations about each of the impairments. Students will make note of the hardest parts of the impairment and the easier parts of the impairment.  After the stations have been completed and snack has been eaten, students will partner up and engage in the “trust walk”. This is an activity to further realize the complication of impaired vision and possibly hearing. One partner will be blindfolded, while the other will be a guide. They will have to guide their partner in different tasks such as walking down the hallway, walking to the water fountain, and walking in and around tables. After a few tasks, the partners will switch and guide the other person.  ***Safety Concern: Teacher will address that when students are guiding their partners they must be very careful and aware of their surroundings. The partner who is blindfolded should move slowly to keep from running into people or objects.*** |
| **EXPLAIN**  **Students will share their ideas with the rest of the class, explaining what their ideas represent and how they will help with the impairment.**  Kim: reiterate the focus questions: “What are some devices that can help impaired senses to be functional?”   * Once all groups have had a chance to explore all the stations, they will have time to discuss, in a group, their ideas on how to repair impaired senses. * After the groups have had time to talk with one another, we will talk as a class and share our ideas with all the groups. * Choose station that they struggled with and create a device that will help with that device. Ideas of what to include is the design, the   Activity:  Students will engage in a productive discussion about their thoughts on each of the stations. They will share some of the ideas they wrote on their notes pages and share which were the hardest or easiest. Students will also brainstorm ideas they think will help the fix the impairments. Teachers will write a chart on the board with each of the ideas. Some examples could be contact lenses/glasses, white canes, hearing aids, etc. Students will also get the chance to design a “blueprint” for a device to “fix” their impaired sense. Each person can choose the sense they struggled the most with to create their design. They will think of the materials needed, purpose, and reasoning of why that device helps with the impaired sense. |
| **ELABORATION**  **Students will discuss what they can do in their everyday lives to make healthier life choices.**  Kim:   * *After completing this activity, watching a couple videos, and looking through our PowerPoint, what types of devices can you think of (that weren’t mentioned in class) that could make life easier if you were to have an impaired sense? Can you invent one using ideas from other devices?*   Activity:  Students will receive an exit slip that will have them list an idea they think will help fix an impaired sense that wasn’t written on the board already. This will show some feedback into the students’ ideas of impaired senses and how medical engineers help to remedy the impairment. |

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th “E”)

The worksheet students fill out will help teachers understand what information the students are understanding in the assignment. Teachers will also be asking questions throughout the activities to keep students thinking about how medical engineers fix sense impairments. Some examples of questions may be:

* “What organ controls this sense?”
* “Does the impairment affect anything else besides this sense?”
* “What are some ways people can help themselves if they have an impaired sense?”
* “Do medical engineers think about all partial sense impairments?”
* “Do you know anyone who has a sense impairment? Do they have any technologies to help them with the impairment?”

Embedded formative assessments written in blue

I) GEARING UP/GEARING DOWN

**1. Gearing up:**

Students will engage in activities that are even harder to accomplish which simulates a higher level of impairment. Examples of this could be that students will have to accomplish a task without the sense of sight or touch and have to make a paper ball into the trash can. Students will not be able to use their hands and will have to close their eyes.

Create a design that is not one they created in the “explain” activity.

**2. Gearing down:**

Students will have less tasks to accomplish with the sense impairment. Students will not have as many sounds to identify, things to pick up, or as severe of impairments to simulate. For example, if a student were to be at the “touch” station, they will have to try to pick up the objects without using their thumbs.

(Insert any handouts here)



**Saturday Science Teaching – Fall 2016**

**Fifth Lesson Plan (5)**

**Grades K-1**

**A)    LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)**

* **Senses**
  + Students will be able to explain what senses are **and** demonstrate how to use them with simple objects to increase their observation skills.
* **Soil**
  + Students will build on their prior knowledge of senses, and gain a more complex knowledge of their senses, and how they can use them to compare and contrast complex objects and their properties. This will be connected to then determining soil types.
* **Force and Motion: Boats**
  + Students will plan out and design a functioning boat using resources given to them, and collaborating with their team.
  + Students will optimize their boat by using certain objects in different shapes and formats in order to move their boat faster down water.
* **Force and Motion: Planes**
  + Students will be collecting and analyzing data based on the materials provided to determine the best aerodynamic flying object by folding it  \*things that fly the longest, looking for the best flight time.
  + Students will compare the materials that they used to build the plane, recognizing key differences in the actual material to determine which one flies the best with their fold pattern.
* **FOCUS QUESTION:**
  + *How can you use the knowledge you’ve gained about senses, soil, and force & motion to compete in various competitions?*

**B) STANDARDS**  (see<http://www.doe.in.gov/standards/science>) )

**Senses Standards**

***Science and Engineering Process Standards:***

**SEPS.8 Obtaining, evaluating, and communicating information**

Scientists and engineers need to be communicating clearly and articulating the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations, as well as, orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to obtain information that is used to evaluate the merit and validity of claims, methods, and designs.

***Content and Practice Standards:***

**K.PS.1** Plan and conduct an investigation using all senses to describe and classify different kinds of objects by their composition and physical properties. Explain these choices to others and generate questions about the objects.

**K.PS.4** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

**1.ESS.2** Observe and compare properties of sand, clay, silt, and organic matter. Look for evidence of sand, clay, silt, and organic matter as components of soil samples.

**1.ESS.3** Observe a variety of soil samples and describe in words and pictures the soil properties in terms of color, particle size and shape, texture, and recognizable living and nonliving items.

**Soil Standards**

**1.ESS.2** Observe and compare properties of sand, clay, silt, and organic matter. Look for evidence of sand, clay, silt, and organic matter as components of soil samples.

**1.ESS.3** Observe a variety of soil samples and describe in words and pictures the soil properties in terms of color, particle size and shape, texture, and recognizable living and nonliving items.

**1.PS.2** Predict and experiment with methods (sieving, evaporation) to separate solids and liquids based on their physical properties.

**Boat & Airplane Standards**

**K.PS.2** Identify and explain possible uses for an object based on its properties and compare these uses with other students’ ideas.

**K.PS.3** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

**K.PS.4** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

**K-2.E.2** Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.

**C)    MATERIALS (asterisk (\*) = any materials that may be a safety concern)**

* Foil (one roll)
* Coffee
* lemon
* Metal
* Clip boards
* Pencils
* Paper plates
* Paper cups
* Cardstock (6 pieces)
* Construction paper (6 pieces)
* Printer paper (6 pieces)
* Box fan (two)
* Styrofoam (12)
* Paper clips
* Clay (molding clay)
* Masking tape
* Straws
* Plastic Wrap
* Toothpicks
* Skewers
* Rubberbands
* Pencils
* Fabric
* 6 stopwatches

**D)      TEACHER CONTENT KNOWLEDGE**

* **Knowledge of Senses/Observation:** Teachers will know all five senses and how to use them in order to observe objects outside. Teachers will also know how to identify mystery objects using their senses.
* **Knowledge of Soil:** To achieve the lesson objectives, the students will need to be able to distinguish the different components of soil. Soil is the scientific term for dirt and is mainly composed of different sources (clay, sand, silt, humus, rocks & pebbles). The basic three components however are clay, sand, and humus (listed below). Thus, for the students to be able to observe and recognize these components in the soil they found around the Education building, we will first have them use some of their 5 senses to observe the components individually before attempting to locate them in the soil they collected. Below is a list of these components, their basic descriptions, and what they often look like or their purpose in the soil. Following the list you will also find what we expect our students to be able to do.
  + **Clay-**a stiff, sticky fine-grained earth, typically yellow, red, or bluish-gray in color and often forming an impermeable layer in the soil. It can be molded when wet, and is dried and baked to make bricks, pottery, and ceramics ***(material deep in the earth that is sticky and easily molded when it’s wet, and will turn hard when it’s baked in an oven.)***
  + **Sand-**a loose granular substance, typically pale yellowish brown, resulting from the erosion of siliceous and other rocks and forming a major constituent of beaches, riverbeds, the seabed, and deserts. ***(small, grainy soil you find on the beach or lakes)***
  + **Humus-** the organic component of soil, formed by the decomposition of leaves and other plant material by soil microorganisms. ***(dark-brown or black material made from decaying (dead) plants and animal matter. Very healthy for plants because it provides nutrients for them, just like certain foods gives us nutrients to stay healthy).***
  + **Potting soil-**a mixture of loam, peat, sand, and nutrients, used as a growing medium for plants in containers. ***(mixture of dirt and other pieces of matter from the earth that helps plants grow).***
* **Knowledge for Boats:** We, the teachers, conducted the same type of investigation, to see which boat design could move the fastest, in relationship to push and pull, as well as motion. Push and pull are both forces, and force makes an object move or stop moving. Through this activity, students will learn this about motion and forces through trial and error, where they will redesign their boats and variables in order to increase their speed of the boat.
  + Push - force to move something away from something else.
  + Pull - force to move something toward something else.
  + Motion - the process of being moved.
  + Force - physical action of moving something.
* **Knowledge for Planes:** We, the teachers, as well as the students, have conducted the same type of investigation, in the previous session. However, now we are focusing on planes and the idea of distance. Distance measures the amount of space between two objects. Through this activity, students will learn this about motion and forces through trial and error, where they will redesign their planes and variables in order to increase their distance their planes can go.
  + Distance- the amount of space between two locations or objects.
  + Motion - the process of being moved.
  + Force - physical action of moving something.
  + Push - force to move something away from something else.
  + Pull - force to move something toward something else.

Students will be investigating different topics that we have talked about the first four weeks of Saturday Science. They will be using what they have learned to compete in the olympics. They will be using their data, that they have collected over the weeks, as a team to create the best boat, paper airplane, and to identify different objects using senses. For example they will be making a verbal claim to our focus question about the airplane that has the longest flight time. They will be looking at their data and determining the best model and material to use for their final airplane and creating this product. They will do this for the boat as well. Then they will compete in the Olympic games at every station (4 total= boat, planes, senses, and tug a rope) and we will determine an overall Saturday Science Champion team.

**TENTATIVE TIMELINE:**

* + - Wrap up and discuss the airplane lab *(9:30 - 9:50)* **AMBER / BRADY / MISSY**
      * Record data on big data chart / decide BEST plane to use
    - Discuss each competition for the Olympic Games and rules/procedures. *(9:50-10:05)* **KATIE AND BRITTANY**
    - Compete in games *(10:10-10:40)* ***ALL TEACHERS***
    - Snack/Break *(10:40-11:00)*
    - Compete in games *(11:05-11:35)* ***ALL TEACHERS***
    - Medal Distribution *(11:40-12:00)* **ELISABETH**
      * https://www.youtube.com/watch?v=ckGB\_mLrheM

**G)     DESCRIPTION OF YOUR LESSON**

**ENGAGE**

When the students walk into the classroom, we will be playing an olympic song (<https://www.youtube.com/watch?v=ckGB_mLrheM>) for them to get into the mood of what we’re doing for the day! We will start off with a conclusion from last week. We will go over the group data and have the students decide on the plane that they will make for the Olympics. They will be choosing the plane that has the longest flight time based on their data from the previous weeks. The IU teachers will each be at one table group helping to facilitate. Then one of the lead teachers will introduce each game of the Olympics, and the other teacher will discuss the rules/procedures for the day. Since our explore phase takes up most of the day, our explanation of the games and playing of the song will be how we engage the students into our activities for the day.

Some questions we will be sure to ask are: *What are the topics that we have talked about over the past weeks in Saturday Science? What are the five senses scientists use? What was the idea we talked about with our boats and planes?*

**EXPLORE**

During the explore phase, the students will compete in the olympic games. The games will be played in stations, where the students are either timed on speed or tested by distance/ability. Each game will test the knowledge they’ve learned from the previous lessons.

*Games*:

* + - Airplane Toss
      * Students will apply their previous knowledge of what they have learned through the unit and apply it to the Olympics games. For the airplane test, students will have designed an airplane that they think will travel the furthest, this ties into what they have been learning about motion.
      * Some questions we will be sure ask are: *Which materials/design traveled the longest? What helped the plane to have the longest flight time?*
    - Sense/ Relay Race
      * For the Sense/Relay race, students will be placed in teams and have to identify a mystery object by using their sense. Once the child has uncovered what the object was, they will be able to tag the next teammate and then it’ll be their teammate’s turn, etc.
      * Some questions we will be sure ask are: *How do you use your senses to identify objects? Which sense helps the most to identify objects?* 
        + Smell: **coffee**, vanilla, cinnamon
        + Taste: chocolate, **lemon**, salt
        + Touch: cotton ball, play doh, **sandpaper**
        + Hearing: duck, cricket, **bell**
    - Tug Of War
      * Students will participate in a Tug of War competition, this game applies what students have learned about push and pull
      * Some questions we will be sure ask are: *“Are you using push or pull force? How can you tell?”*
    - Boat Race
      * Students will use the boat they created in Week 3 to race against the other boats. Students will be competing for fastest boat time. This game will apply to what they learned about force and motion
      * Some questions we will be sure ask are: *“Is the wind a push or pull force on the boat? How can you tell?” “What factors make your boat go faster?”*

The first 2 stations will take place before snack, and the next two will take place after snack.

**EXPLAIN**

Students will come back to the classroom to discuss their experiences during the olympic games, and determine which games communicated and put into practice the standards we had set for the students to learn. Students will have a class discussion about which events their team excelled in, and which event their teams did not, and why. During this time, supporting instructors will tally up each team's points to determine a first, second, and third place team. Then, as a class, we will have a closing ceremony, where the winning teams receive medals and will stand on the “podium.”

**Possible questions to ask students:**

*“Which event was the most challenging? Why? Which event was the least challenging? Why?”*

*“Which event used the idea of push and pull?” (This can be changed to senses, force, motion, flight time, etc)*

**ELABORATION**

For the elaboration phase, our discussion with the students about their experiences during the games will be discussed and written down on the board. Students can refer to this in order to reflect back on what they learned. Elaboration will also come during the games, when the students talk to each other about what will work/not work in the activity they’re doing.

**Possible questions to ask students:**

*“Which fold will make/did make this (plane) travel farther?”*

*“How can/did you make the boat travel faster?”*

*“How can/did you use your senses to identify the type of soil?”*

**H)     EMBEDDED FORMATIVE ASSESSMENT (the 5th “E”)**

Since the students will not have a tangible assessment for the olympic games, i.e. a packet or worksheet, the assessment will come from the discussion we have with them after the games about what worked, what didn’t work, what they excelled in, and what they may not have done so well in, and why. This assessment will essentially be their reflection back on what they’ve learned during Saturday Science and what they’ll take away.

**I)    GEARING UP/GEARING DOWN**

**1. Gearing up:**

If the activities are too easy, students will have to depend more on each other to complete the games, rather than help guidance from the instructor. This includes designing and making their boats and planes. This also will force them to communicate without the instructor monitoring, or translating the students’ ideas.

**2. Gearing down:**

If these activities are too hard for the students, instructors will step in to help guide students while designing and building their boats and planes, as well as work as a translator to help students express and formula their ideas, and communicate them to the other members of their teams.

Handout for Teacher:

|  |  |  |  |
| --- | --- | --- | --- |
| **Boat Race (s)** | **Plane Race (s)** | **Tug of War**  **(circle one)** | **Senses Relay**  **(Tally)** |
| Time: | Time: | Win    Lose | Smell: |
| Time: | Time: | Win    Lose | Taste: |
| Time: | Time: | Win    Lose | Touch: |
|  |  |  | Hear: |
| Average Time:\_\_\_ | Average Time:\_\_\_ | Total:\_\_\_/3 | Total:\_\_\_/16 |

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