Q405/E548 Saturday Science Teaching – Spring 2018
How do I work?

LESSON 1 - Circulatory System
2nd & 3rd

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

- Students will be able to describe what purpose the heart has within the circulatory system has, as well as identify the main components of the heart.
- Students will be able to demonstrate the function of the heart in the circulatory system.

B) STANDARDS (https://www.nextgenscience.org/)

- What science and engineering practices are you addressing in this lesson:
  → Asking questions (for science) and defining problems (for engineering)
  → Developing and using models
  → Analyzing and interpreting data
  → Constructing explanations (for science) and designing solutions (for engineering)
  → Engaging in argument from evidence
  → Obtaining, evaluating, and communicating information

- What cross cutting concepts are you addressing in this lesson:
  → Cause and Effect
  → System and System Models
  → Energy and Matter
  → Structure and Function

C) TEACHER CONTENT KNOWLEDGE (As a teacher, describe what you need to know regarding the concepts you've identified for each bullet above)

- Circulatory system's main components consist of the heart (an organ), blood vessels, and the blood. The circulatory system is your body's delivery system. Your heart plays an important part in being healthy. It keeps all the blood in your circulatory system flowing. Blood helps oxygen get around your body. Blood travels through the blood vessels.
- The heart acts as a pump for the circulatory system that maintains the flow of blood by changing fluid pressures around the body. Before each beat, your heart fills with blood. Then its muscle contracts to squirt the blood along. When the heart contracts, it squeezes — try squeezing your hand into a fist. That's sort of like what your heart does so it can squirt out the blood. Your heart does this all day and all night, all the time.

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

6 groups!

Expectations:

- Chart paper (1 sheet)

Stethoscope:

- Paper towel cardboard tube (cut in half) (1 half roll per child)
- Duct Tape (1 roll for the whole class to use)
- Red plastic solo cups (1 per child)
- Markers (1 box per group)

Heart Model:

- *beaker or wide mouth jar (1 per group + 1 for IU student demo [7 total])
- Balloon (1 package of balloons [at least 30, regular size])
- Flexible drinking straws (1 box of at least 30; 2 straws for each group/IU students demo)
- *wooden skewer (1 skewer per group)
- *Scissors (1 per group + 1 for IU students demo)
- Water
- Large foil pan (1 per group + 1 for IU students demo)
- Scotch tape (1 per group + 1 for IU students demo)
- Larger pitcher to hold water (1 total)

Exit Slips:

- 24 index cards (1 per student)
- 24 pencils (1 per student)

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

http://www.science-sparks.com/2013/01/20/make-a-stethoscope/
https://www.youtube.com/watch?v=F8wyLRdglxA
https://www.homesciencetools.com/article/how-to-make-a-heart-pump-science-project/
http://kidshealth.org/en/kids/heart.html
http://blog.teachersource.com/2016/08/05/formative-assessment-science-classroom/

F) TENTATIVE TIMELINE (Keep brief)

9:20am Hello! Greet Parents and Kids Enthusiastically
Sign-in and Get Name tags
ALL

9:30am Welcome to Saturday Science!
Name Game **(5-7 minutes)**
Expectations written on chart paper **(5 minutes)**
Introduction to Theme (How do I work?) and today's topic (Circulatory System) **(3 minutes)**

9:45am Create KWL Chart [title: circulatory system]- fill in K and W **(10 minutes)**
Play youtube video **(3 ½ minutes long)**
Fill in L part (what students learned from video) **(3 minutes)**
Stethoscope activity (1st part of explore portion) **(25 minutes)**

10:30am Bathroom/Snack Break - Play Bill Nye Video **(15 minutes long)**

10:45 am Heart model activity & discussion **(60 minutes)**

11:45 am Why is the heart important? What does it do for the body? **(5 minutes)**
Exit slip **(5 minutes)**

12:00pm Clean-up and Parent Pick-up

G) DESCRIPTION OF YOUR LESSON:

9:30-10:45:

1. *Welcome to Saturday science! Raise your hand if you've been to Saturday science before. Welcome back if you have been before, and hello if you are a newbie! We can't wait to explore science with you and get to know each of you better!*
2. Name Game: *So, before we get started, we need to introduce ourselves! We're going to play a short name game to do so. At your table, work with the person next to you. Tell them your first name and your favorite type of candy or candy bar! Your partner then has to repeat your name & your favorite candy, and then say their name and favorite candy. Then we will share with the class everyone's name and favorite candy. Us IU students will show you what we mean!* (IU Students can demonstrate what this looks like while they introduce themselves.)
3. Expectations: *Now that we know one another, we need to talk about our how we all will behave during Saturday science. I'll write the ideas we come up with on this piece of paper* (chart paper). *What are some rules you have in your classroom at school or at home?* (come up with ~5 big rules, then tape the chart somewhere visible to everyone in the classroom)

4. Introduction to theme: *We will be learning about the human body - what are the systems that keep our bodies moving and working? We won't have time to cover them all, but we will get to cover some of the most important ones! This week we are learning about the circulatory system!*

ENGAGE:

Focus Question:

How does the heart work? Why is it important for the body?

1. Draw a KWL chart on the board [title: Circulatory System] (1 IU student should fill out this chart as we see what students know, want to know)
    a. Questions we could ask: *does anyone know what the circulatory system is or does?* (the system that circulates blood through the body) *Why do we need blood flowing in our body?* (blood carries nutrients to all parts of the body that we need to survive!) Students might not know these answers yet, but we will write down their ideas.
    b. *Can anyone think of a body part that helps pump blood through the body?* (the heart!) *Yes, the heart! The heart is a giant muscle that pumps blood through your body.*
    c. *What else is a part of the circulatory system? Think about this: what liquid does the heart push throughout your body?* (blood!) *Yes, blood is a big part of this system.*
    d. *There's one more part of our body that is involved in this system. Think about this: how does the blood move around in our bodies? Just willy-nilly? (Hint: look at your wrists. What are those blue lines you see under your skin called?)* (veins!) *Yes, veins, or blood vessels, are tiny tubes that have blood flowing through them.*
    e. *So, now we know all the body parts involved in the circulatory system.*
    f. *Do you have any questions you want to add to our chart? What do you want to know about the heart?*
    g. *We're going to leave this chart on the board so that we can add to it as we learn today.*
2. Play YouTube video. *Did you learn anything new that we can add to our chart?*
3. Move to part 1 of explore portion

EXPLORE & EXPLAIN:

Make Stethoscope: (during this portion, 1 IU student should be taking notes on our KWL chart, marking what we already know, want to know, and have learned) **25 MINUTES**

1. Ask students *if they know where their heart is located? [have them hold their hands over it] Have you ever been to the doctor before and had the doctor listen to your heart? Does anyone know what the instrument is called that they use to listen to your heart? Well, today we're going to make our very own stethoscopes that you can take home!*

2. Each student will receive a cardboard roll.
3. Before having students move to the next step, let them decorate their cardboard tubes with the provided markers.
4. Direct students to put one end of the roll up to their ear, and press the other end of the tube gently on a partner's heart. *Can you hear anything?* ***We have to be totally silent to hear our friends heartbeats!*** *It's sorta hard to hear our heartbeats with this tube, isn't it? I bet we can make the heartbeat sound louder somehow!*
5. Tell students to grab a red solo cup from the center of the table. (holes should be pre-cut into the bottom of the cups by IU students).
6. Direct students to place one end of their tubes into the hole in the bottom of the cup. They should place the tube about 1 inch or so into the cup. IU students will help each person tape their cup to the cardboard tube with duct tape.
7. Now, ask students to *listen to their friend's heartbeat again. Can you hear it better? Is the sound louder? What do you think made it louder and why?* **Remind them to be totally silent during this portion.**
8. Tell students, *I bet your friend's heartbeat is pretty slow and steady. What do you think their heart would sound like if they were exercising or running? Let's try it out!*
9. At this point, have students stand up and jog in place for 60 seconds. Then direct them to listen to their friend's heartbeat now. *Does it sound any different? How does it sound different? What do you think this tells us about the heart?*
10. Conclude this portion by stating that *your heart beats faster when you're moving quickly, and beats slower when you're sitting or sleeping. Everyone's heart rate is different, and it changes depending on your age. Your age's sleeping heart rate (how many times your heart beats per minute) is between 40-50 beats! Your sitting heart rate is 90, and your exercising rate is 90 and above! I wonder if you can use your stethoscope to count your family members heart rates at home?*

Make heart model: **60 MINUTES**

1. Tell the class *now that we've listened to our heartbeats, we're going to each make a model of the heart!*
2. IU students will pass out materials to each of the tables (perhaps this could be done during the bathroom/snack break to save time). IU student fills the pitcher full with water and sets aside.
3. *So, you see a bunch of different materials in front of you. These are the things we're going to use to make models of the heart! But first we need to talk about the 3 parts that our heart model needs to have in it. Ask students if anyone has ever seen a model of a heart before. (the heart has 4 chambers, blood, blood vessels). Can anyone tell me what one of the body parts involved in the circulatory system is?* (ask until we hear answers of "the heart, blood, and blood vessels/veins" from students. Kelsey will label these parts on the board while someone draws a picture as students name the different parts.)
4. *So we know that we need our model to show the heart, blood, and blood vessels. Take a look at your materials, and use what you've learned about these body parts. Which item do you think we should use to represent the heart? Remember - the heart fills up*

with blood and lets blood out, so maybe it should be something that can be filled up. (Kelsey will write down students ideas on the board under the "heart" section.)

5. *Okay, let's move onto the blood. We need something to represent our blood… what are your ideas?* (Kelsey will write these on the board under "blood")
6. *Finally, what materials can we use to represent the veins, which let blood pass through them?* (Kelsey will write these materials on the board under the "veins" category).
7. *So now that you have an idea of what body parts you need to have in your model, and some materials you might use to represent those parts, you can take the next 30 minutes to build a model of the heart with your table groups! Your challenge is to build a model of the heart, and if possible, find a way for it to actually show the heart in action (beating!) Be creative and have fun. There are no wrong models here :)* **(This introduction portion will take ~10 minutes)**
8. Students work on their heart models. **(30 minutes)**
9. After students have finished their models, we will allow time for each table group to share the heart model they've made and briefly explain why they made their model that way. **(10 minutes)**
10. *Nice job on your models! I love how creative and scientific you all were in your designs and explanations. Great job! We would like to show you the model we made, too.* (IU students bring out their heart model and show the class how it works). **(5 minutes)**

EXPLANATIONS:
Because we have already had a lot of discussion during the exploration phase, we should have our chart mostly completed. We will add any remaining information we've learned from the exploration activities to the chart (during the elaborate phase). Then we will go over the big ideas once more before the elaborate phase. Students will discuss how the activities connect to what we have been learning about the circulatory system (i.e, what is consist of, and what it does). Additionally what they did during the activities.

ELABORATE:

During the bathroom/snack break, we will pull up the Bill Nye "Heart" episode on Netflix (Collection1 E26) Start: 2:30-

After the heart model activity and discussion we will add more info to our L portion of the chart. We will ask the students why the heart is important to learn about. Then we will do the exit slip.

H) What will you do to learn if your students met the objectives for this week? (FORMATIVE ASSESSMENT - the 5th "E")

Students will complete the following individually.
Exit Slip: pass out an index card to each student. Ask the following questions and tell students to write their answers down on the card.

1. What is the circulatory system and what body parts are involved in it?
2. What is something new you that you learned today about your heart?

I) PEDAGOGICAL FOCUS:
-State the focus for the week (Productive discussions, Science for all etc),
-Explain how you are trying to incorporate this into your practice in this week's lesson

Productive Discussion:
By using the KWL chart as well as the hands on activities we want to encourage our students to talk and discuss with one another their discoveries and new ideas. We hope that through productive discussion it will lead to a better understanding of the circulatory system.
Anticipating - From prior experience discussing this topic with college students (the people in this group) we can anticipate that students may not have a clear idea about what is in the circulatory system and what its function is. We can anticipate that students will struggle to provide information on our KWL chart, but we will know that by the end students will be able to fill it.
Monitoring - As the students are participating in activities we the teachers will ask students questions that tie back to our main focus of what the circulatory system does and consist of. Students will also continue to fill out the KWL chart.
Selecting - For selecting during the heart model activity we will select a few groups with different ideas to talk and share with the class their thoughts. Hopefully there will be different ideas that we can use and compare and contrast them.
Sequencing - Based on students responses we will take this opportunity to talk about their ideas and see what the class thinks choosing specific responses.
Connecting - At the end we will talk about keeping our circulatory system healthy and connect it to what our circulatory system consist of as well as its function.

(Insert any handouts here)

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How do I work?

LESSON 2 - Digestive System
2nd & 3rd

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

- Students will be able to identify the different organs in the digestive system.
- Students will be able to explain and demonstrate, through a variety of means (discussion, written, expressive skit) how the digestive system operates.

B) STANDARDS (https://www.nextgenscience.org/)

- What science and engineering practices are you addressing in this lesson:
  → Asking questions (for science) and defining problems (for engineering)
  → Developing and using models
  → Obtaining, evaluating, and communicating information

- What cross cutting concepts are you addressing in this lesson:
  → Cause and Effect
  → System and System Models
  → Energy and Matter
  → Structure and Function

- What core science ideas are you addressing (ex: force, muscle movement etc)
  → What the digestive system includes and how it works

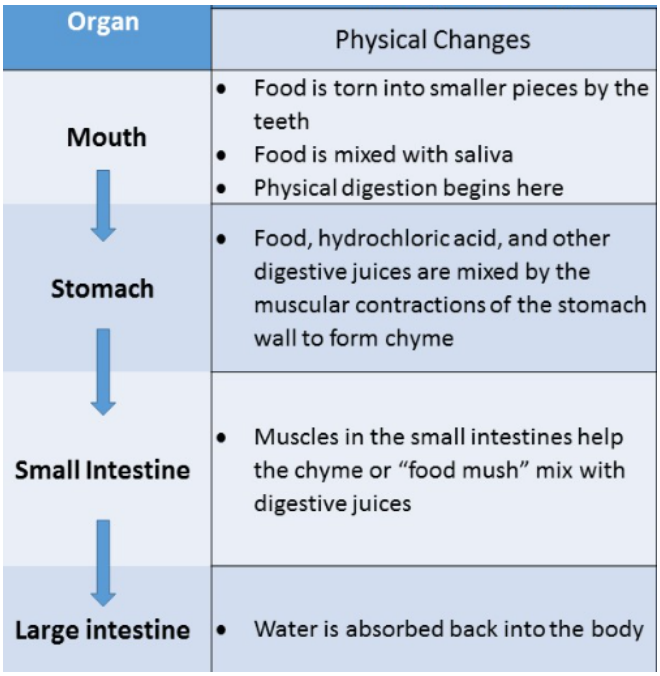
C) TEACHER CONTENT KNOWLEDGE (As a teacher, describe what you need to know regarding the concepts you've identified for each bullet above)

- The digestive system breaks down food to make it easier to process. It has stages: chewing, swallowing, stomach, small intestine, large intestine. Digestion involves the breakdown of food into smaller and smaller components, until they can be absorbed and assimilated into the body so we don't keep in everything that we consume.
- The small intestine absorbs most of the nutrients in your food, and your circulatory system passes them on to other parts of your body to store or use. Special cells help absorbed nutrients cross the intestinal lining into your bloodstream. Your blood carries simple sugars, amino acids, glycerol, and some vitamins and salts to the liver. Your liver stores, processes, and delivers nutrients to the rest of your body when

needed. Your body uses sugars, amino acids, fatty acids, and glycerol to build substances you need for energy, growth, and cell repair.

The digestive system including the following:

- The stomach mixes up food
- The stomach is a muscle
- The stomach is kind of like a "holding tank" for food
- The tongue helps us swallow food
- The food goes down the esophagus to the stomach after it has been swallowed
- Your teeth grind up food into small pieces to be digested by the stomach
- The stomach turns the particles into liquid
- In the intestines some of the liquid is absorbed into the body to be used for fuel. The rest continues through the intestines as waste.



There are four different tooth types in the mouth.

The **incisors** at the front of the mouth have a sharp biting surface and are used for cutting or shearing food into small chewable pieces. There are eight incisors in both primary and permanent dentitions.

The **canines** are situated at the 'corners' of the dental arches. They have a sharp, pointed biting surface. Their function is to grip and tear food. There are four canine teeth in both primary and permanent dentitions.

The **premolars**, unlike the incisors and canines, have a flat biting surface. Their function is to tear and crush food. They are unique to the permanent dentition which has eight premolars.

The **molars** are the largest of the teeth. They have a large flat biting surface. The function of the molars is to chew, crush and grind food. There are eight molars in the primary dentition and twelve in the permanent dentition.

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

Digestive System Drawing:

- Crayons (1 box per group)
- Chart paper (6)
- Scotch tape (1 roll)

Food Crushers Activity:

- Small mirrors (12)
- Paper plates (24)
- Apple (4)
- Banana (1 bunch)
- Celery (1 bundle)
- Pencils (24)
- Knife* (1 for teachers to cut food)
- Copies of FOOD CRUSHERS page (24)

Lemon Juice/Cracker Experiment:

- Zip-top freezer bags (24)
- Lemon juice (one 32 oz bottle)
- Crackers, saltine (1 package, enough for each student to have 1)

- Dixie cups (24)
- Sponges (6)

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

http://science-mattersblog.blogspot.com/search?updated-max=2011-02-28T00:01:00-08:00&max-results=7&reverse-paginate=true

Magic School Bus digestion episode (S1E2, on Netflix)

http://pbskids.org/sid/parentsteachers/media/pdf/sid_activity_digestion.pdf

https://vimeo.com/213672378

https://www.dentalhealth.ie/children/toothdevelopment/types.html

F) TENTATIVE TIMELINE (Keep brief)

9:20am	Hello! Greet Parents and Kids Enthusiastically Sign-in and Get Name tags **ALL**
9:40am	Welcome to Saturday Science (again)! Reiterate Expectations Introduction to Theme (How do I work?) and today's topic (Digestive System)
9:45am	Provide students with definition of digestion and explain activity **(3 minutes)** Have students fill in body with digestive system organs **(20 minutes)** Complete Food Crushers activity & worksheet **(20 minutes)**
10:30am	Bathroom/Snack Break - **(15 minutes long)**
10:45 am	Discuss stages of digestion **(5 minutes)** Lemon Juice/Cracker experiment **(30 minutes)** Sponge activity to follow lemon juice (demonstrates intestines role)
11:15am	In their groups create a skit of the digestive system **(20-30 minutes)** Students perform skits **(10 minutes)**

12:00pm Clean-up and Parent Pick-up

G) DESCRIPTION OF YOUR LESSON:

ENGAGE: Focus Question: What happens to your food after you eat it?

- *Can anyone tell me what they think*at our body gets nutrients from our food - write this on the board so students can re *the digestive system is? What is digestion?* (the process of breaking down food so thfer to the definition throughout the class). *If you look on your table, you'll see a piece of paper with the shape of a human body on it. We want you to work with your table mates to draw how the digestive system works in your body. It's okay if you don't know all the body parts involved - or even how they work! We just want to see how much you already know about the digestive system :) Use the definition of digestion that we have given you & think about the order of how your body might digest food. Draw the body parts involved.*
- Students complete their digestion system drawing. IU students walk around and make observations of student's drawings, taking note of which tables have really good examples, drawings, etc.
- After they've finished, we collect their drawings and tape them to the front board. We ask each group which organs they included, and then label the organs accordingly. *So I see that a lot of groups included a mouth, stomach, and small and large intestine* (for example)*, can someone raise their hand and tell me why their group included those parts?*
- *Awesome job! It looks like you folks already know a lot about the digestive system. Now we're going to move onto a fun, food-eating activity.*

EXPLORE:

Food Crusher Activity and Worksheet **(20 mins)**

1. Ask class initial questions: *Where do you think digestion begins? What do you think happens to food that you eat when it's in your mouth? Why is chewing important for digestion?* (think, pair, share)
2. *We're going to explore what happens to different kinds of food when you chew it.*
3. *We're going to take 3 different fruits and vegetables and see how we chew them differently. We're going to take each piece one by one and look at our mouths in the mirror. This will be the one time it's okay to chew with your mouth open!* **Have volunteers pass out paper plates to each student, all with one piece of fruit/veggie on them, 1 mirror to each student, and 1 worksheet to each student. TELL THEM TO WAIT FOR FURTHER INSTRUCTION BEFORE EATING**
4. *We want you to look at each piece of food as you chew it, and observe the way you chew the food and what part of your mouth you use to chew! Pay attention to which teeth chew the food.* **(5 mins to explain)**

5. *Let's start with the banana. Everyone, pick up the banana and chew it, while looking at your mouth in the mirror. Make a note on your worksheet about which teeth are used to chew the banana.* Repeat this process with the apple, then the celery (Softest to hardest). Teachers will circulate the classroom to help answer questions when filling out the worksheet. Make sure students answer as many questions as they can on the worksheets. **(10 mins)**
6. Wrap up with questions: *What did you discover from our experiment? How are our front a back teeth different and alike? (*The front teeth can chew softer foods, while the back teeth can chew more fibrous/tough food, like the celery!) *Which teeth did you use for the bananas/apple/celery? What are some other foods you can think of that you eat with your front/back teeth/tongue?* (i.e., back teeth-steak) *What is the purpose of the saliva in our mouths?* (the saliva moistens food to help break it down, and swallow easier). *What do you think your tongue is doing?* (the tongue not only has taste buds that let you taste your food, but it also helps push the food you have chewed down your throat!) **(5 mins)**
7. Take bathroom/snack break.

Lemon Juice and Cracker Experiment **(30 mins)**

1. *So, we've learned so far that digestion starts with chewing our food. But what happens after that? Where does our food go?* (the stomach!) *Exactly, food travels to our stomach after we swallow it. So does anyone know what the stomach does to the food once it's in there?* (there's acid in the stomach that breaks down food. Kids might ask what acid is -*Acid is a sour-tasting chemical that dissolves other things*.) Now we're going to make a model that shows how the stomach works!
2. IU students pass out materials to each student (1 ziplock baggie with 1 saltine cracker inside, 1 dixie cup of lemon juice)
3. *Looking at your materials, which item do you think is supposed to be our "stomach?"* (the plastic baggie)
4. *Which item is our "stomach acid?*" (the lemon juice)
5. *Which item is the food we are digesting?* (the saltine cracker)
6. *Exactly. So, the first part of digestion is chewing, which would have already happened before the food made it to the stomach. So we need to "chew" our food by breaking the saltine cracker into little pieces. Carefully use your fingers to crush the saltine cracker into pieces inside of the baggie.*
7. *Now, let's all pour our "stomach acid" into our "stomachs."*
8. *Close the bag tightly, making sure to let out any extra air in the bag.*
9. *Now shake up the bag! Use your fingers to "massage" to mixture together. This is like the action of the muscles that cause our stomachs to squeeze food during digestion.*
10. *Talk with a partner at your table about what's happening with the cracker. How is this like a stomach?* <u>(think, pair, share)</u> (possible answer: the stomach is a muscle that "massages" the food with stomach acid to break it down).
11. IU students pass out 1 sponge to each table group.
12. *So we have seen how the stomach works to digest food. But where does it go next?* (allow for any student responses - the answer is the small intestine first, then large)

13. *The small intestine is the next step in the digestive system. This sponge is going to help show us how the small intestine works! What do sponges do?* (soak up liquid). *Exactly. Place your sponge into one of your table's "stomachs." What is it doing?* (soaking up the liquid!) Allow time for sponge to soak up as much liquid as possible. *Is there anything left behind in the bag?* (there should be small bits of cracker left, and maybe some excess liquid). *The small intestine soaks up the nutritious liquid and then the large intestine soaks up the excess liquid from the indigestible residue. What do you think is the purpose of the small intestine soaking up the nutritious liquid?* (This is how we get energy from our food)*. Yep! The nutritious liquid is transferred to your blood cells, where the circulatory system delivers it to different parts of your body! And what does the large intestine do?* (gets rid of stuff in our body that doesn't give us energy.)
14. *Can anyone tell me what we've just learned about the small and large intestines?* (wait for students to answer)
15. *So, what happens to the waste that the large intestine soaks up? Where does it go, and what happens to it?* (it exits the body via the rectum).

EXPLANATION:
Explain the process of what happens when you eat a piece of food using a specific example. Give a piece of this food item to your students. Have them eat it while you explain what is happening to the piece of food that they are eating. For example, tell your students that their teeth is grinding the food in their mouths. After the food is broken down, it will go through the esophagus. Point to the esophagus and ask your students if they feel the food there. Explain that the food item they ate will go to the stomach after it leaves the esophagus. Explain to your students that the food is broken down in the stomach and goes through the small intestine after it leaves the stomach. Tell your students that the energy they get from the food is because the blood picks it up from the small intestine and delivers it to the cells. Explain that the leftover food goes to the large intestine and the large intestine enables it to the exit the body.

ELABORATE:
Students will discuss what they observed during the food crushers activity and the lemon juice activity with the group. We can connect this to what students already knew about the digestive system and how these new observations change their understanding.

- Possible extension activity (in case we have extra time):
    - My Food Plate worksheet

H) What will you do to learn if your students met the objectives for this week? (FORMATIVE ASSESSMENT - the 5th "E")

- **Skit:** Students will model how the digestive system works in their groups through a skit. This will be how students show they know the organs in the digestive system as well as how food is digested.
    - *You've learned so much about the digestive system today! Now it's time for you to show us how much you remember :) You and your table mates are going to*

come up with a skit, where you act out how the digestive system works. Think about the parts of the digestive system that we have discussed, and make sure to include those in your skit.

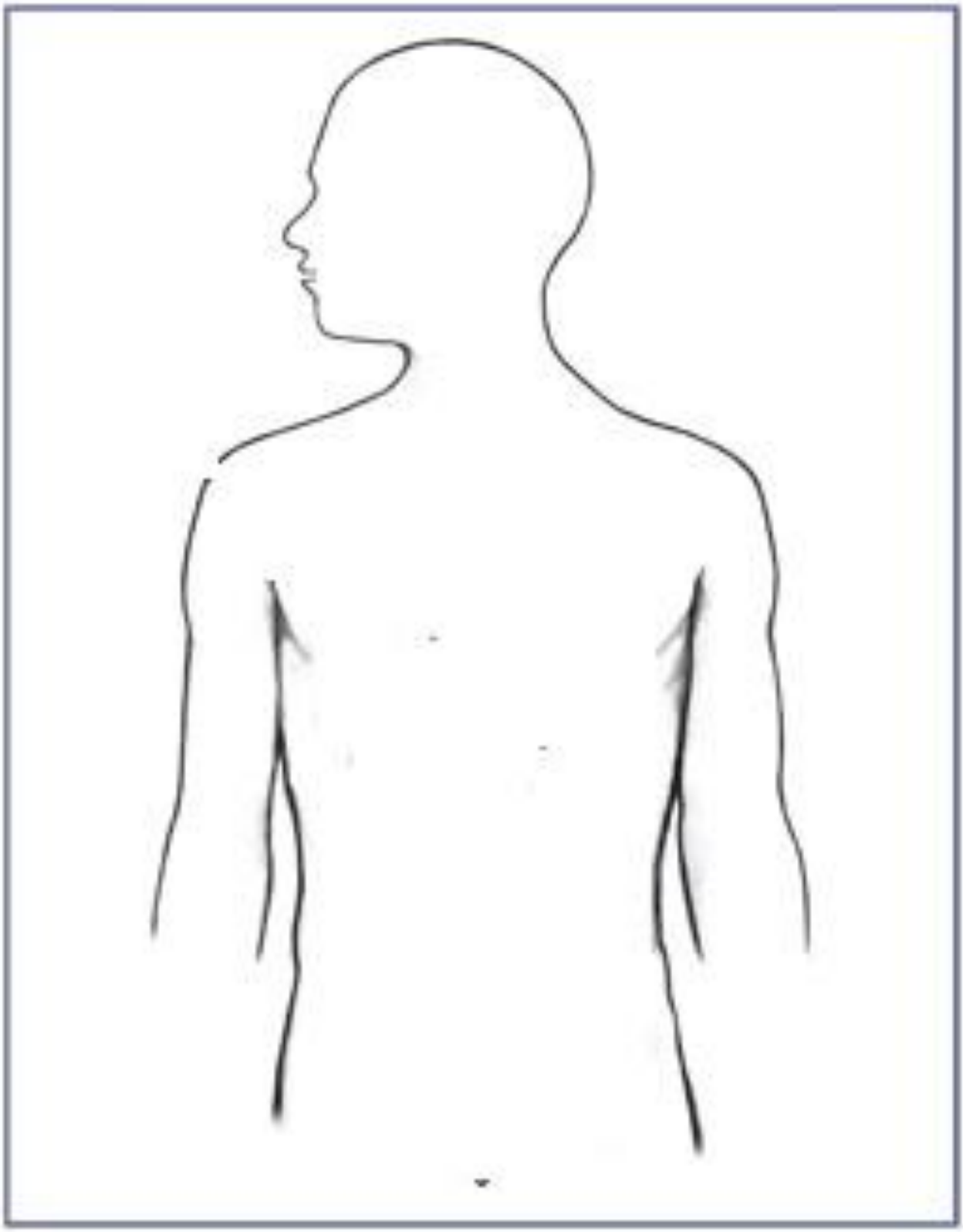
- *What body part is each person in your group going to represent? How are you going to model what that body part does in the body (i.e., the mouth chews the food into pieces).*
- *Feel free to stand up and practice your skit. You have about 25 minutes to come up with your skit.*
- *When you're finished, you'll present your skit to the rest of the class. It doesn't have to be very long at all! Have fun and be creative!*
- Students present their skits to the class.

I) PEDAGOGICAL FOCUS:

Science for All:

By providing students with a number of different activities we are catering to as many possible forms of learning for our students. Additionally, we have students working in groups or with a partner at all times so there is always support. We will have students do a few think, pair, share discussions so that those who are shy will be more likely to speak in front of the class when we bring it back to a whole-class discussion. There are written (worksheet) as well as oral (think, pair, share; whole-class discussions) responses, hands-on activities (lemon juice/cracker, food crushers), and kinesthetic evaluations (the skit). Some of our activities also allow students to be visually creative through drawing (digestive system organs). Students are able to demonstrate their knowledge in various different ways. Specifically for one student we are providing other options that he will feel more comfortable doing on his own rather than working in a group.

FOOD CRUSHER WORKSHEET:
https://www.scholastic.com/magicschoolbus/parentteacher/activities/lunchprint.pdf



Q405/E548 Saturday Science Teaching – Spring 2018
How do I work?

LESSON 3 - Musculoskeletal System
2nd & 3rd

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET

1. Students will be able to explain the functions and purposes of the musculoskeletal system in the human body.
2. Students will be able to compare and contrast muscles and bones.
3. Students will be able to assemble a model of the hand that accurately mimics the movement of the muscles and locations of the bones.

B) STANDARDS (https://www.nextgenscience.org/)

- What science and engineering practices are you addressing in this lesson:
  → Asking questions (for science) and defining problems (for engineering)
  → Developing and using models
  → Obtaining, evaluating, and communicating information

- What cross cutting concepts are you addressing in this lesson:
  → Cause and Effect
  → System and System Models
  → Energy and Matter
  → Structure and Function

- What core science ideas are you addressing (ex: force, muscle movement etc)
  → Muscle movement and the parts of your body that allow muscle movement to be possible.

C) TEACHER CONTENT KNOWLEDGE (As a teacher, describe what you need to know regarding the concepts you've identified for each bullet above)

The musculoskeletal system's primary functions include supporting the body, allowing motion, and protecting vital organs (with muscles, bones, and joints)

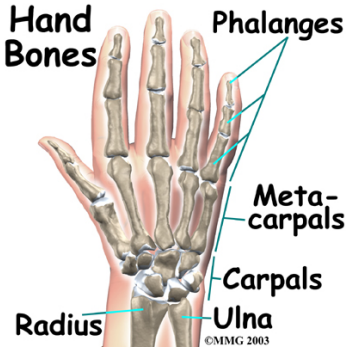
Muscles:

- Muscles, attached to bones or internal organs and blood vessels, are responsible for movement. Nearly all movement in the body is the result of muscle contraction.
- The muscles in your body are there to shorten or contract, a simple but very important task. Every movement you make is driven by the muscular system, from a simple smile to lifting a heavy box.
- The muscles inside your forearm have long tendons running through ligament fibers, known as the carpal tunnel, in the wrist. These muscles allow you to flex your

fingers, bending the tips towards your palm, as your fingers do when giving the thumbs up. This is what happens when you pull on the strings of your model hand

Bones:

- The bones provide stability to the body.
- The skeletal system serves as a framework for tissues and organs to attach themselves to. This system acts as a protective structure for vital organs. Major examples of this are the brain being protected by the skull and the lungs being protected by the rib cage.



Joints:

- Joints are structures that connect individual bones and may allow bones to move against each other to cause movement. Without joints, the bones would rub against each other in a painful way - they are constructed to allow for different degrees and types of movement.

Muscles, Bones, and Joints:

- The bones provide stability to the body. Muscles keep bones in place and also play a role in the movement of bones. To allow motion, different bones are connected by joints. Cartilage prevents the bone ends from rubbing directly onto each other. Muscles contract to move the bone attached at the joint.

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

Assessment:

- pencils (24)
- Notecards (24)

Musculoskeletal drawing activity

- Chart paper (6 pieces)
- crayons (1 bucket per table like usual)

Muscular System Hand Craft

- string (2 rolls)
- Scissors (6)

- scotch tape (6 rolls)
- Cardstock paper - cut into large hands (1 package)
- drinking straws (2 boxes [clear]; we have already taken what we need)

Hand Bone Activity

- bottle baby oil (1)
- q-tips (24)
- condiment cups (24)
- paper towels (1 roll)
- Newspaper (enough to cover the 6 lab tables)
- construction paper (24 pieces)

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

https://www.livinglifeandlearning.com/muscular-system-hand-craft-for-kids.html
https://mysteryscience.com/trending/mystery-1/bones-animal-structures/161?r=14103256#slide-id-3653
https://www.teachertube.com/video/bill-nye-bones-muscles-223780

F) TENTATIVE TIMELINE (Keep brief)

9:20am Hello! Greet Parents and Kids Enthusiastically
Sign-in and Get Name tags
ALL

9:40am Welcome to Saturday Science (again)!
Reiterate Expectations
Introduction to Theme (How do I work?) and today's topic ***Have students move around and see if they can guess today's topic***
Introduce students to musculoskeletal drawing activity

9:45am Have students complete musculoskeletal drawing activity & share **(20 minutes)**
Discuss bones in your hand **(5 minutes)**

Complete Hand Bone activity **(30 minutes)**

10:40am Bathroom/Snack Break - Bill Nye - https://www.teachertube.com/video/bill-nye-bones-muscles-223780 **(15 minutes long)**
Set up materials for muscles activity

10:55 am Discuss muscles in your hand **(5 minutes)**
Complete Muscular System Hand Craft **(30 minutes)**

11:30am Take students to 4th floor to hang up their hand bone projects **(20 minutes)**
Students answer jeopardy question on a notecard **(10 minutes)**

12:00pm Clean-up and Parent Pick-up

G) DESCRIPTION OF YOUR LESSON:

ENGAGE:

Focus Question: How does my body move, support, and protect itself?

Introduction:

1. *So, we've been learning about the human body over the last 2 weeks. Does anyone have any idea what body system we will be covering today? Here's a hint: stand up and move your body around. What allows us to be able to move around like this?* (our muscles and bones!)
2. *Today we're discussing the musculoskeletal system. This really means our muscles and bones and how they work in our body.*
3. *Like we did last week, we want you to draw what you think the muscles and bones inside our body look like. Use the crayons and chart paper to do so! Then we will share all of our drawings with the class.*
4. Students complete drawings.
5. We collect and share drawings
6. *It looks like you all have some good ideas about what our muscles and bones look like in the body! Now we're going to move onto an activity where we examine the bones located in our hands.*

Engage portion of Bones activity:

1. Ask the class, so, *what do bones do for your body? Why are they important?* (think, pair, share). *What ideas did you come up with?* (document their ideas on the board)
2. Play the following video that discusses bones and their purposes (stop at 2:01)
3. Have students move their hands and examine them - *think about the bones inside. We're going to do an activity where we draw our hands, and what the bones look like inside. But we can't see our bones, can we? How do we know where they are? You can figure it out by paying attention to all the places your hand can bend. Take the next minute to explore your hands. Curl your fingers, make a fist, see if you can feel your bones by touching your hands like this* (demonstrate)*. Take 1 minute to do this.*
4. *What did you notice? Which parts of your hand do you think bones are in?* Discuss student's observations.

EXPLORE:

Begin hand bones activity:

5. Cover the lab tables with newspaper. Pass out all other materials.
6. Demonstrate the activity under the doc camera, so that students can follow along with you. Place a light-colored piece of construction paper under the doc camera. Use a dark-colored crayon to trace your hand, making sure to include a tracing of your wrist and half of your forearm.
7. *You may have noticed that the places where your fingers bend, or where there are joints, are located where there are wrinkles on your skin* (show on camera). *With your hand back on the paper, and using your crayon, mark a line next to each of these joints. Then draw a line across the fingers to mark each joint.*
8. *Make a fist, find your knuckles. Where are they?* (at the bottom of our finger bones) *How many do we have?* (5!) *Exactly. Make a fist, like this* (demonstrate), *and mark on your paper where your knuckles are located. Your knuckles are joints!*
9. *Now, we're going to add our finger bones! How many do we have in each finger?* (3, besides 2 in the thumb)*. Don't forget to leave space between the bones where the joints are.*
10. *Where else does our hand bend, besides the fingers?* (the wrist) *Exactly. Put your hand back on the paper, and bend your wrist back. This is another joint. Mark on your paper where your wrist bends back. Draw a line straight across.*

11. *Draw the 5 palm bones based on this x-ray picture of a hand*

12. *Do you see the 8 small bones that make up your wrist in this picture? Draw a circle for each one.*
13. *Now draw the two forearm bones.*
14. *How many bones have we drawn total? Does anyone know?* (add them together on the board if not)
15. *Now use your crayon to color the area around the bones. Make sure to not color the bones!*
16. *Now, dip your qtip in the oil. "Color" in the bones with the oil. Make sure not to put too much oil on the q tip. You want enough, but not too little or too much.* (demonstrate what too much looks like, what too little looks like). *Is everyone ready to move on?*
17. *Now, write your name on your sheet! We're going to let these dry, and then later we will hang them up on the windows to see the light shine through them. They're going to look like real x-rays!!*
18. *Do the "explain portion" of bones.*

Muscles in Hand: (demonstrate all steps under the doc camera)

1. Pass out materials to each student
2. Line up the straw segments on the hand cut out

3. Use clear tape to secure the straw segments to the paper, without covering the ends of the straws.
4. Tape the 5 pieces of yarn to the back of each finger.
5. Thread the strings through the straws.
6. Pull the strings to see how your hand moves!
7. Discuss student's thoughts on the hand model. Do they think it's accurate?
8. Do explain portion of hand model.

EXPLANATION:

Bones:

We did this activity so that we could see how the inside of our own hands might look as an X-ray. Oil makes the paper translucent which gives us an X-ray effect. This activity helps to give us an overall better understanding of how our own hand bones work and what joins them together to help us use our hands for everyday tasks. Can someone tell me what bones do in our bodies? (give us "structure", allow us to bend and grab things, make complex movements). Bones wouldn't be so great without joints, because then our bones would scrape against another all the time!

We were able to do this by observing our hands - can someone tell me what observe means? (noticing something) *How do scientists use observations to do science?* (Scientists use **observation** to collect and record data, which helps them come up with predictions and do tests to find something out. Scientists observe in many ways – with their own senses or with tools such as microscopes). *We observed our hands today. What did we do to find out where our bones were?* (felt our hands, bent them, looked at the wrinkles on our skin). *After we made the observations, we could infer where our bones were inside our hand. What does* ***infer*** *mean?* (making a conclusion based off of your observations). *Can someone tell me again what we observed from this activity? And what could be infer from our observations?* (checking for student understanding). *Exactly! We did a fun experiment where we used our observations to make inferences. Nice work :)*

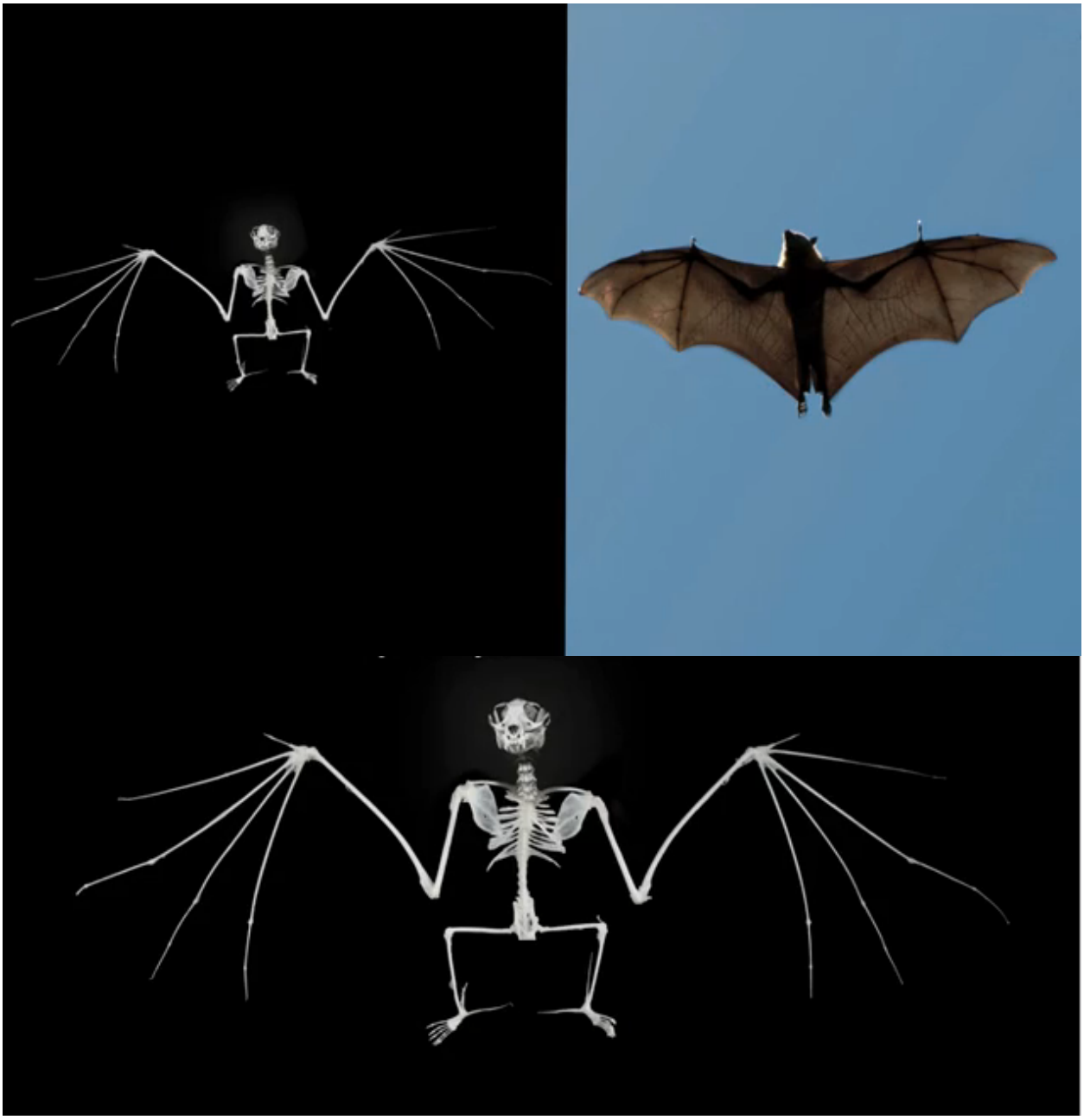
Muscles:

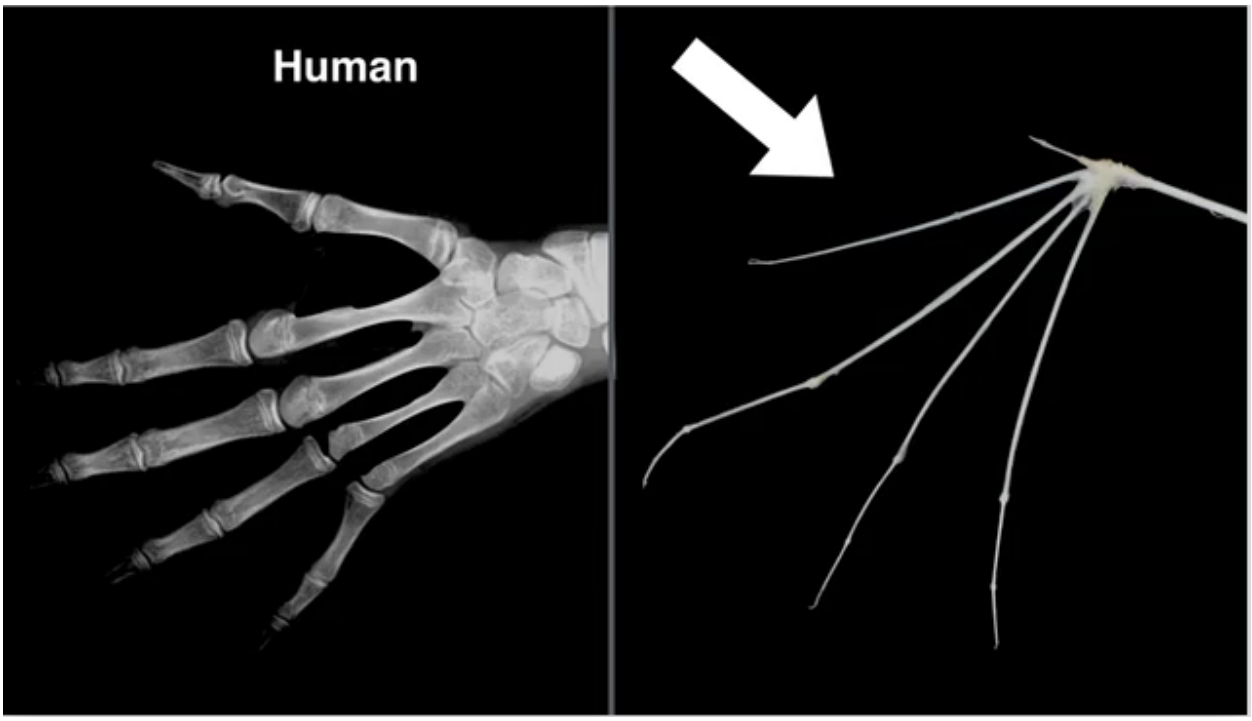
(The muscles inside your forearm have long tendons running through ligament fibers, known as the carpal tunnel, in the wrist. These muscles allow you to flex your fingers, bending the tips towards your palm, as your fingers do when giving the thumbs up. This is what happens when you pull on the strings of your model hand)

We did this activity so that we could better understand how our muscles help our bodies move. But they need to work together with our bones to do this. The straws represent the bones in our fingers, but also serve the purpose of holding the strings in place that represent finger muscles. Once all of the straws and strings are in place, pulling the strings at the bottom of the hand moves the paper hand as our real hands move with bones and muscles. This activity helps us to understand how our hand muscles work and how they help us perform everyday tasks. *Our muscles are a very unique part of our bodies, since they're the only tissue in our bodies that contract. When we pull the strings, that shows our muscles contracting to create movement.* We've covered our bones in the last activity, so this

one helps us to show how our muscles work together with our bones. Without our muscles, or bones we could not move our hands, they use teamwork to help us move!
Can anyone tell me how this was similar to our last activity? And can anyone tell me how it was different? What can we learn from seeing our paper hands move? What do our muscles do that no other tissue does that helps us move? (Our muscles contract)

ELABORATE:
If time allows, we will show the following x-ray of an animal "hand" to students on the doc camera. We will say: *We observed our hands by touching and looking at them, and we were able to infer where our bones were located and how that helps our hands move like they do. Now I want you to look at this x-ray of an animals hand bones. Tell me what you can infer from the image, based on your observations! How are the bones different looking from ours, and what could that mean about how the animal looks, or what the animal can do with their hands? What animal do you think it is? Think about it for a minute and then turn and tell a partner. What did you infer from this picture?* (show the next image of the full skeleton.) *What do you think now? Raise your hand if you have a guess?* (Show the next image.) *It was a bat all along! We used our observations from what we learned about our own hands, and what we saw in the bat x-ray, to infer what animal it was and how it could move. Nice work!*





H) What will you do to learn if your students met the objectives for this week? (FORMATIVE ASSESSMENT - the 5th "E")

- **What Is the Question to this Answer?** Give students an answer and have them come up with a question, Jeopardy style. This simple, quick exercise will let you know who grasps the concept and who needs further instruction.

On the board we will have a slide that says "Is made up of muscles, joints, and bones. It's job is to provide support and movement for your body." Students will then write "What is the Musculoskeletal System?" on their notecard.

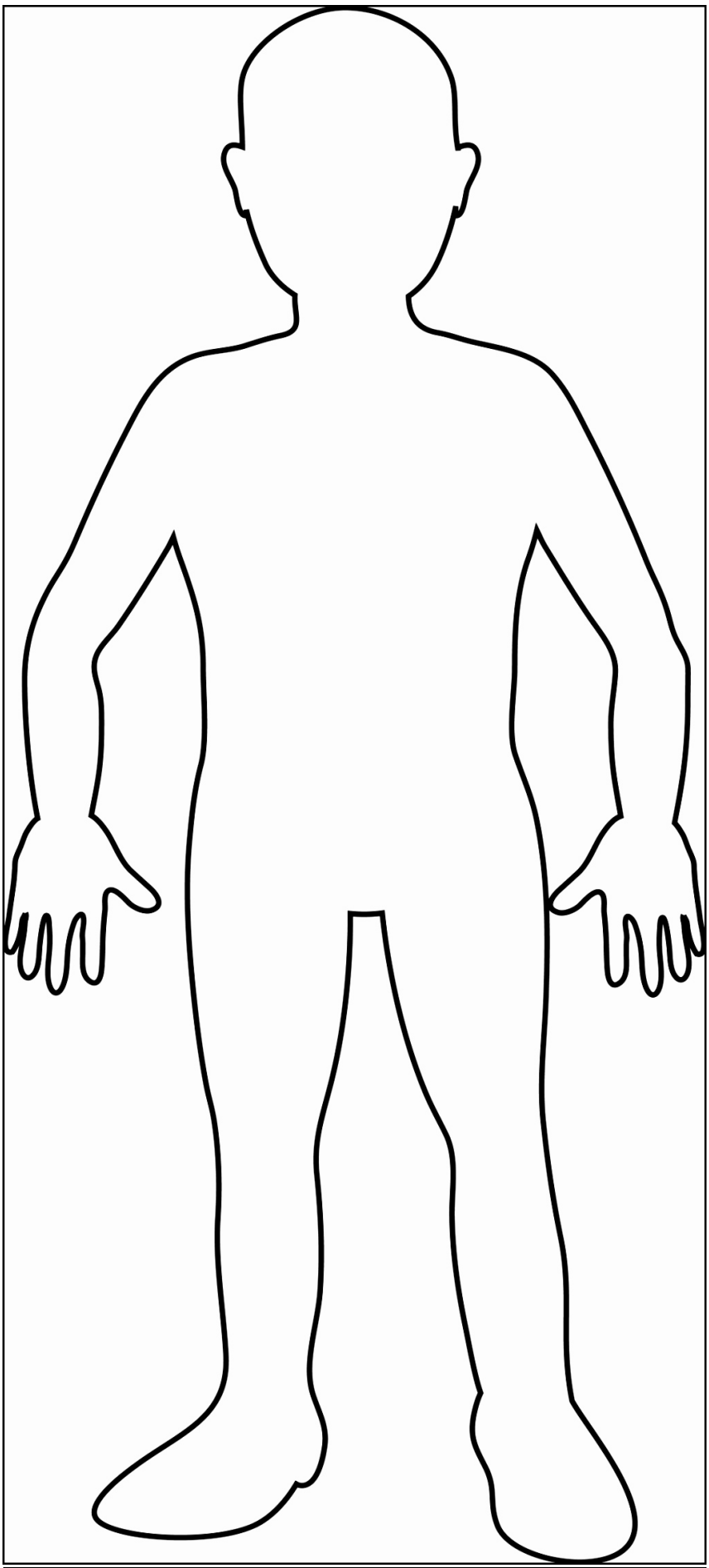
I) PEDAGOGICAL FOCUS:

What is science: A focus on NOS

Creativity - Students will learn about the creativity of science in during the hand bone and hand muscle activities. Both activities involve observation & inference and creativity, but we will be using only the hand muscle model to explicitly discuss creativity with the students. After the activity, we will ask students, *"what was creative about this activity?"* Then we will explain, *scientists use creativity all of the time. Even thinking of a way to test an experiment is creative, right? Scientists have to use their imaginations all of the time! We used our imaginations when we observed our hand bones. After we observed, we had to imagine what the bones looked line under our skin. Someone had to be creative when making this model, too! I bet the person observed their hands and tried to think of the best model to show how the hand bent. You have to be creative to do science and be a scientists!* By explicitly discussing creativity with students and providing them with several examples, they will be

much more likely to view science in a realistic way, and hopefully enjoy doing science more.

Observation and Inference - Students will observe the way their hands move and feel, and based on this they will infer how many bones there are in their hand and what the bones help us do. We will first complete the drawing hand bones activity, and then move into discussion of the NoS observation & inference tenet. Here we will explicitly discuss what an observation is, how scientists use/make observations, and how observations help us infer something. We will define these terms and provide examples for students to make sense of the terms. In the elaboration portion, if we have time, we will take this tenet further by asking students to observe an x-ray of a mystery animal hand, and make inferences based off of their observations.



Q405/E548 Saturday Science Teaching – Spring 2018
How do I work?

LESSON 4 - Respiratory System
2nd & 3rd

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET

- Students will be able to identify features of the respiratory system and describe their basic functions.
- Students will be able to construct a model of the lung and relate it to the human lungs.
- Students will be able to collect data on their lung capacities and make inferences based on the data.

B) STANDARDS (https://www.nextgenscience.org/)

- What science and engineering practices are you addressing in this lesson:
  → Asking questions (for science) and defining problems (for engineering)
  → Developing and using models
  → Analyzing and interpreting data
  → Constructing explanations (for science) and designing solutions (for engineering)
  → Engaging in argument from evidence
  → Obtaining, evaluating, and communicating information

- What cross cutting concepts are you addressing in this lesson:
  → Cause and Effect
  → System and System Models
  → Energy and Matter
  → Structure and Function

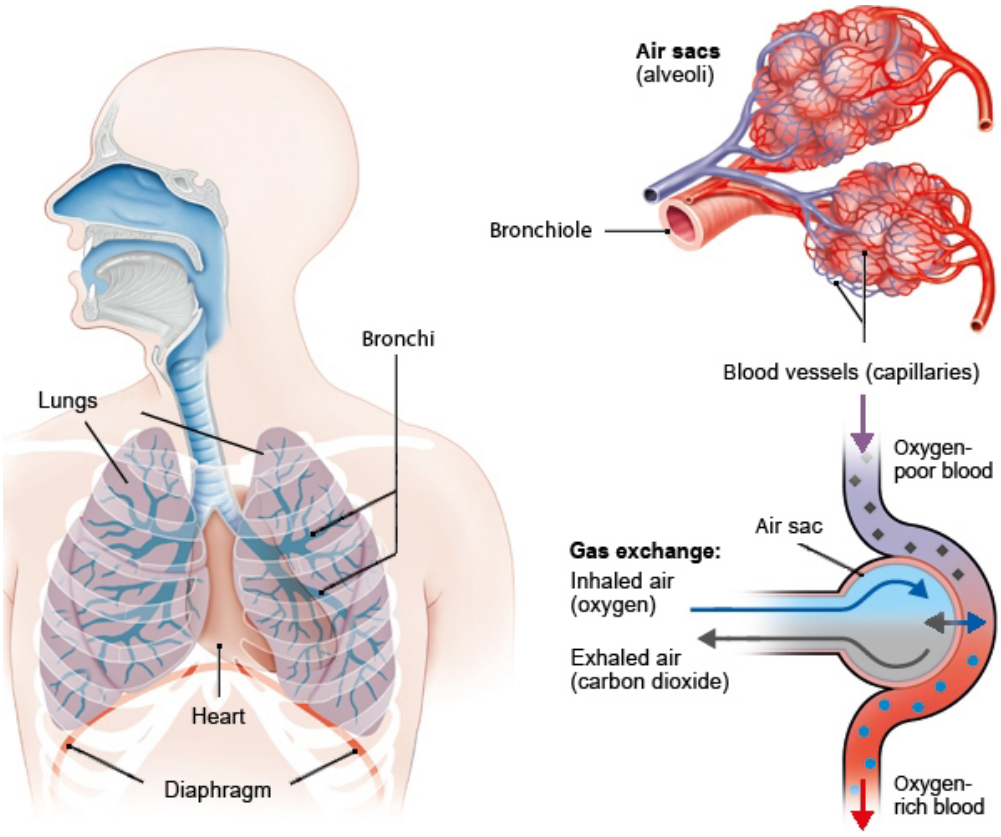
- What core science ideas are you addressing (ex: force, muscle movement etc)
  → How our lungs supply oxygen to the body/release carbon dioxide as waste

C) TEACHER CONTENT KNOWLEDGE (As a teacher, describe what you need to know regarding the concepts you've identified for each bullet above)

- Respiratory system supplies oxygen to all the parts of your body. It does this through breathing: inhaling oxygen and exhaling carbon dioxide, which is a waste gas.
- Your lungs are the main component of the respiratory system. They are like 'sacs' that fill up with oxygen as you breathe in. Each of the sacs get deposits of oxygen

and when the blood reaches your lungs as it is pushed from the heart it circulates into the walls of the lungs and picks up the rich oxygen. The blood then carries this oxygen throughout your entire body.

- The lungs are located in the chest region, protected by the ribs in the rib cage. Their structure can be compared to that of an upside-down tree: The windpipe branches into two airways called bronchi, which lead to the lungs. Inside the lungs, the airways keep branching into narrower airways until the air sacs are reached.



-
- When you breathe in, air containing oxygen enters your windpipe, passes through the bronchi and eventually reaches the air sacs. These air sacs, called alveoli, are responsible for gas exchange. They look a bit like grapes at the end of the bronchial branches. Healthy lungs have about 300 million air sacs in them. Each air sac is surrounded by a network of fine blood vessels (capillaries).
- The oxygen in inhaled air passes across the thin lining of the air sacs and into the blood vessels. This is known as diffusion. The oxygen in the blood is then carried around the body in the bloodstream, reaching every cell. When oxygen passes into the bloodstream, carbon dioxide leaves it. Carbon dioxide is a waste product of cellular metabolism. You get rid of it when you breathe out. This gas is transported in the opposite direction to oxygen: It passes from the bloodstream – across the lining of the air sacs – into the lungs and out into the open.

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

Lung Model

- Water bottles (25 total)
- Balloons (2 for each student; 50 total)
- Scissors (24 total, if possible)

Lung capacity activity

- Balloons (24 total)
- Paper (could be printer paper or lined paper, 24 total)
- Pencils (24 total)
- String (6 rolls if possible)
- Meter sticks (12 if possible)

Assessment Drawing/Craft:

- Printout of human upper body (25 total) *attached on last page of LP*
- Crayons (1 bucket per table)
- Pipe cleaners (1 package)
- Packing peanuts (1 container)
- Liquid glue (6 total)

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

http://www.primarythemepark.com/2014/07/human-body-activities-respiratory-system-model/
https://www.youtube.com/watch?v=8NUxvJS-_0k
https://www.youtube.com/watch?v=H62wTF9vKPQ
http://www.healthworldeducation.org/resources/item/166-top-10-gasp-worthy-facts-respiratory-system
https://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0090029/

Netflix Bill Nye Respiratory Episode

F) TENTATIVE TIMELINE (Keep brief)

9:20am Hello! Greet Parents and Kids Enthusiastically
Sign-in and Get Name tags
ALL

9:40am Welcome to Saturday Science (again)!
Reiterate Expectations - emphasize chairs (2 warnings)

Introduction to Theme (How do I work?) and today's topic (Respiratory System)
True/False game

10:00am Lung Model Activity/Discussion **(30 minutes)**

10:30am Bathroom/Snack Break - Bill Nye - Netflix S1E10 **(15 minutes long)**

10:45 am Lung Capacity Activity/Data Collection **(45 minutes)**

11:30am Respiratory system assessment **(30 minutes)**

12:00pm Clean-up and Parent Pick-up

G) DESCRIPTION OF YOUR LESSON:

ENGAGE

Focus Question: How do I breathe?

1. Remind students what body systems we've learned about so far (circulatory, digestive, musculoskeletal). Ask if anyone has any guesses about what system we're learning about today (respiratory!)
2. Ask students what they can tell you about the respiratory system. What does respiration even mean? (the action of breathing). How do we breathe? (through our mouths/nose, it comes to our lungs). What type of air do we inhale? (oxygen). Why do we need air? (without it, we would die!)
3. Tell students that they're going to learn so much more about the respiratory system as the morning goes on, but for now we're going to play a quick true/false game.
4. Instruct students to stand up.
5. Tell students that you're going to read several statements about the respiratory system. If they think the statement is true, they stay standing. If they think the statement is false, they can sit back in their chair.
6. Do 1 simple practice statement (i.e., "Today is Saturday") so that students understand what actions to do for true/false.
7. Read the following statements:
    a. Hairs in the nose help clean and warm the air we breathe (TRUE)
    b. Children breathe at a faster rate than women and men (**TRUE**)

c. If you could flatten out the lungs and all the things inside of the lungs, it would be the size of a football field! (**FALSE**, it would be about the size of half of a tennis court!)
d. We lose about 12 oz of water of water a day through breathing (**TRUE**, like when you blow on a window and it fogs up, that's because of water vapor coming out of your mouth!)
e. Lungs are the only human organ that can float in water (**TRUE**, little sacs inside the lungs fill up with air, making the lungs able to float)
f. Yawning is caused by your body not taking in enough oxygen from the air, which causes a shortage of oxygen in our bodies. The brain senses this shortage of oxygen and sends a message that causes you to take a deep long breath (**TRUE**)
g. Both the right and left lung are the same size (**FALSE**, left is smaller so there's room for the heart!)
h. A person at rest usually breathes between 12 to 15 times a minute (**TRUE**)

EXPLORE

Lung Model:
[to complete before students arrival]
1. Cut off the bottom of the bottles (about 2 inches).
2. Sand down the edges with sandpaper.

[to complete with students]
1. Under the doc camera, instruct students to take the first balloon and cut off the tip of the balloon with the scissors (about 1 inch, make sure they aren't cutting the neck of the balloon end!)
2. Show students how to fit the balloon around the bottom of the water bottle. The neck of the balloon should be poking out of the bottom of the bottle. There should be no space between the balloon and the bottle.
3. Instruct students to grab the other balloon, and insert it into the top of the water bottle, holding the "neck" of the balloon.
4. Invert the neck of the balloon and wrap it tightly around the mouth of the water bottle.
5. Make sure everyone is on track and their balloons fit tightly on the bottle in both places.
6. Show how the model works!
7. Complete explain portion of the activity.

Lung Capacity:
1. Give each student a balloon, a sheet of paper, a pencil, string. Place 2 meter sticks at each table.
2. Remind students not to touch their materials until instructed.
3. *Now we're going to see how much our lung capacity is. Does anyone know what capacity means?* (the max. amount that something can hold). *Our lungs have a certain capacity, which is the amount of air they can hold and release in one breath.*

4. *We're going to measure how much air each one of us can release in one breath. To do this, we're going to take our balloons, take a deep breath in, and then try to fill up our balloons as much as we can in ONE BREATH!*
5. *One partner will do this with the balloon. When they are done, they will pinch the neck of the balloon so that no air comes out. The other partner will use the string to measure how wide the balloon is. We will demonstrate this for you.* (demonstrate)
6. Then, you need to place the string along a meter stick to measure how long it is. Measure in inches! (show this under doc camera)
7. Record your length.
8. Switch partners.
9. Repeat steps 5-7.
10. Meanwhile, draw a table on the board to document class data.
    a.

Age	Avg. Capacity (inches)
Age 7	data
Age 8	data
Age 9	data

    b.
11. Record class data on the board. Ask students to raise their hand if they are 7 years old. Get their data. Repeat for other 2 ages (8, 9). Find the average of all the data, record that on the board.
12. Ask the class, *does our data show anything about our lung capacities and ages? Do people who are younger have lower capacities than older people? Is the data mixed? What about our (IU student) lung capacities?*
13. *Now we're going to see if our lung capacities change when we exercise for 1 minute. One partner will exercise for 1 minute, and then repeat the process. Then switch turns with your partner!*
14. Meanwhile, make a 2nd graph on the board.
15.

	Before Exercising Capacity Avg. (inches)	After Exercising Capacity Avg. (inches)
Age 7	Previous data	New data
Age 8	Previous data	New data
Age 9	Previous data	New data

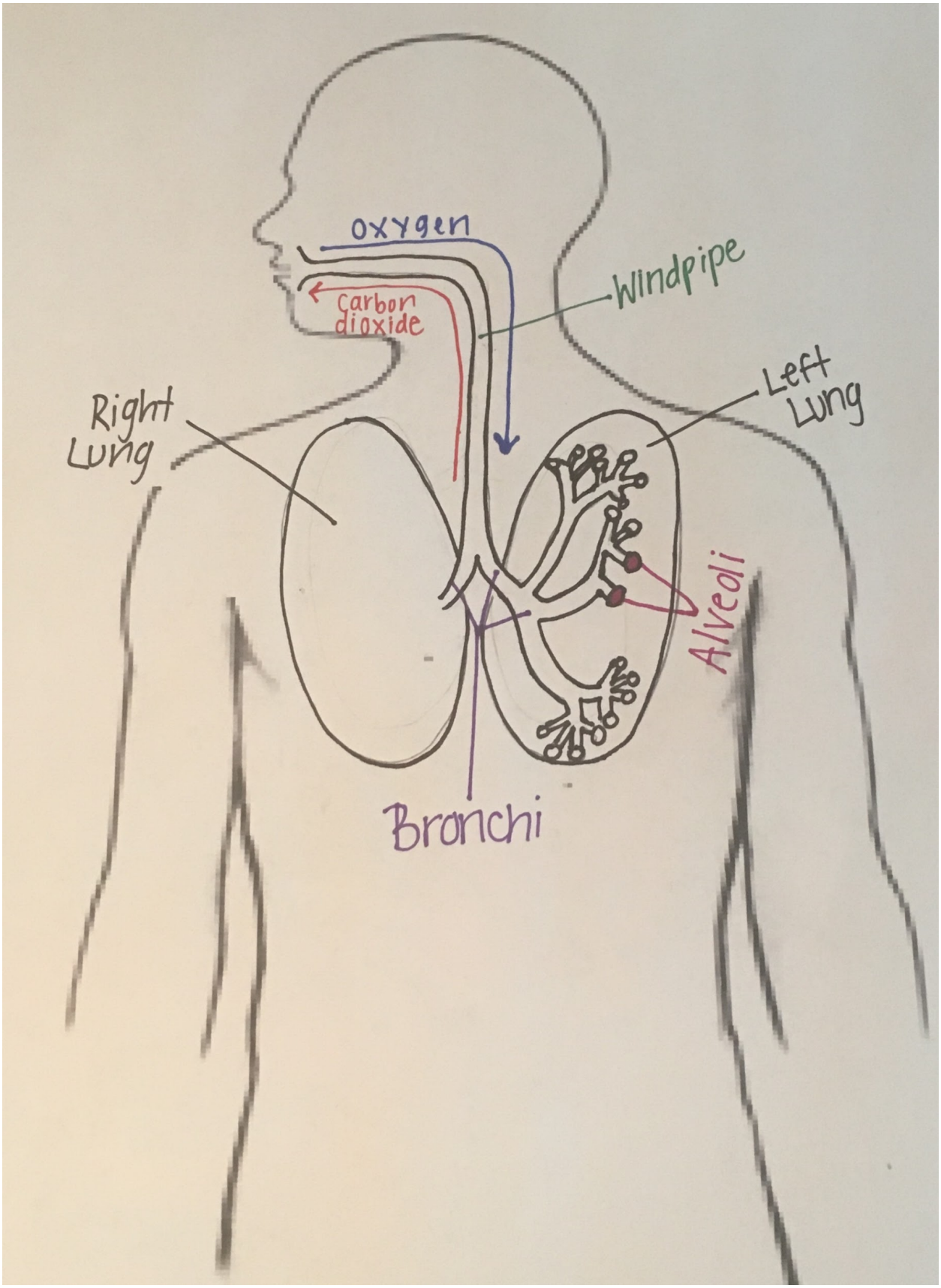
EXPLANATION

<u>Lung Model:</u>

1. After finishing the model, ask students, *how does this model show how breathing our lungs work? Does anyone have any ideas? Does anyone know what muscle the bottom balloon is acting as?*
2. Play this video after discussion. As the video plays, explain how *the lungs inflate with air as we inhale, pushing the diaphragm downward and flattening it out. This allows the lungs to have room to expand!* (relate this to our model). *As we exhale, the lungs get smaller, and the diaphragm rises back up and stretches out.* (relate this to our model).
3. *Ask students what the water bottle represents* (our chests/body). *Ask what the bottom balloon represents* (diaphragm).. *Ask them what the balloon inside the bottle represents* (one lung).. *Ask how many lungs our model is representing* (to make sure there are no misconceptions that we only have 1 lung, like our model).
4. *Can anyone think of something the models aren't showing us? We see how the lungs and diaphragm work, but what else are we missing?* (what type of air is coming in and out of the body, where the air is going once it's inside your body).
5. *This model does a good job of showing us how the lungs and diaphragm work inside your body. But now we need to discuss in more detail how breathing works.*

ELABORATE

6. Place one of the assessment worksheets under the document camera and display it on the SMARTboard. Ask a student to tell you *what the first step of breathing is* (inhaling air!) Draw this on the worksheet using a blue arrow coming in to the mouth and down the windpipe. Label this "oxygen."
7. *Where does the air go next?* (into the lungs). *How many lungs do we have?* (2!) Draw both lungs, making sure the base of the windpipe breaks off into 2 tubes, each one going into the right/left lung.
8. *These tubes that go into each lung are called the bronchi. They branch off, like a tree, into tiny little "limbs" that are just smaller bronchi.* Draw and label these parts.
9. *Next, as the air travels through these bronchi, it reaches the end of the tubes and fills up tiny little sacs, called alveoli. They kind of look like grapes! There are about 300 million of these air sacs in a healthy person's lungs!* Draw some of these air sacs and label them.
10. *From here, the oxygen from the air seeps through the air sacs and is then taken to the blood, where it travels throughout your whole body to give your cells oxygen!*
11. *What kind of air comes out when we exhale?* (carbon dioxide).
12. *The body needs the carbon dioxide to come out when we exhale. So, when the oxygen passes to our blood, the carbon dioxide stays behind. The carbon dioxide travels backwards - moving from the alveoli, through the bronchi, back up the windpipe, and is blown out of our mouths when we exhale.* Draw the carbon dioxide coming up from the lungs and back out of the mouth.
13. *So that's how we breath! It seems like a lot of work just to breath - thankfully we don't even have to think about it for our body to do it!!* (Image of what this should like at the end).

14. 
oxygen
carbon dioxide
Windpipe
Right Lung
Left Lung
Alveoli
Bronchi

15. End the explanation by challenging students to take these models home and find a way to make their own model that has both lungs, and that shows the oxygen coming in and the carbon dioxide coming out. They could even try to include the bronchi and alveoli!

H) What will you do to learn if your students met the objectives for this week? (FORMATIVE ASSESSMENT - the 5th "E")

Students will be given a sheet of paper with the upper body of a human outlined on it. They will use various materials to draw/craft a model of the respiratory system. They need to show the gases that come in the body through breathing and out of the body through exhaling. They need to include the major body parts involved (windpipe, lungs, diaphragm) and if possible the bronchi and alveoli. We will collect these sheets at the end of class to assess what students took away from our lesson! As long as they successfully identify the 2 gases we inhale/exhale and the windpipe and lungs, we will be satisfied. If they include the other parts that would be exemplary!

I) PEDAGOGICAL FOCUS:

STEM Integration:
Science: Students will be learning about the respiratory system and demonstrating their knowledge by completing a number of activities (making lung models, finding their lung capacities, following a walk-through of the respiratory processes, assessment drawing). They will also collect scientific data, which will be used to draw inferences about our lung capacities.
Technology: Students will be using various tools to collect their lung capacity data (pencil & paper, string, and meter sticks).
Engineering: Students will be designing and creating a model of the lung with water bottles and balloons.
Art: Students will be using different materials to construct a model of the respiratory system which we will use as assessment at the end of the lesson.
Math: Students will be collecting data about their bodies and lung capacity and placing it on a class chart/graph. They will then analyze this data to make inferences about lung capacities compared to age and exercising.

Q405/E548 Saturday Science Teaching – Spring 2018
How do I work?

LESSON 5 - Central Nervous System
2nd & 3rd

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET

- Students will be able to identify features of the central nervous system and describe their basic functions.
- Students will be able to connect the functions of the brain to their abilities to smell, see, hear, touch, and taste.
- Students will be able to be able to state one thing they learned from each Saturday science lesson.

B) STANDARDS (https://www.nextgenscience.org/)

- What science and engineering practices are you addressing in this lesson:
  → Asking questions (for science) and defining problems (for engineering)
  → Analyzing and interpreting data
  → Constructing explanations (for science) and designing solutions (for engineering)
  → Engaging in argument from evidence
  → Obtaining, evaluating, and communicating information

- What cross cutting concepts are you addressing in this lesson:
  → Cause and Effect
  → System and System Models
  → Energy and Matter
  → Structure and Function

- What core science ideas are you addressing (ex: force, muscle movement etc)
  → How our body processes and receives signals

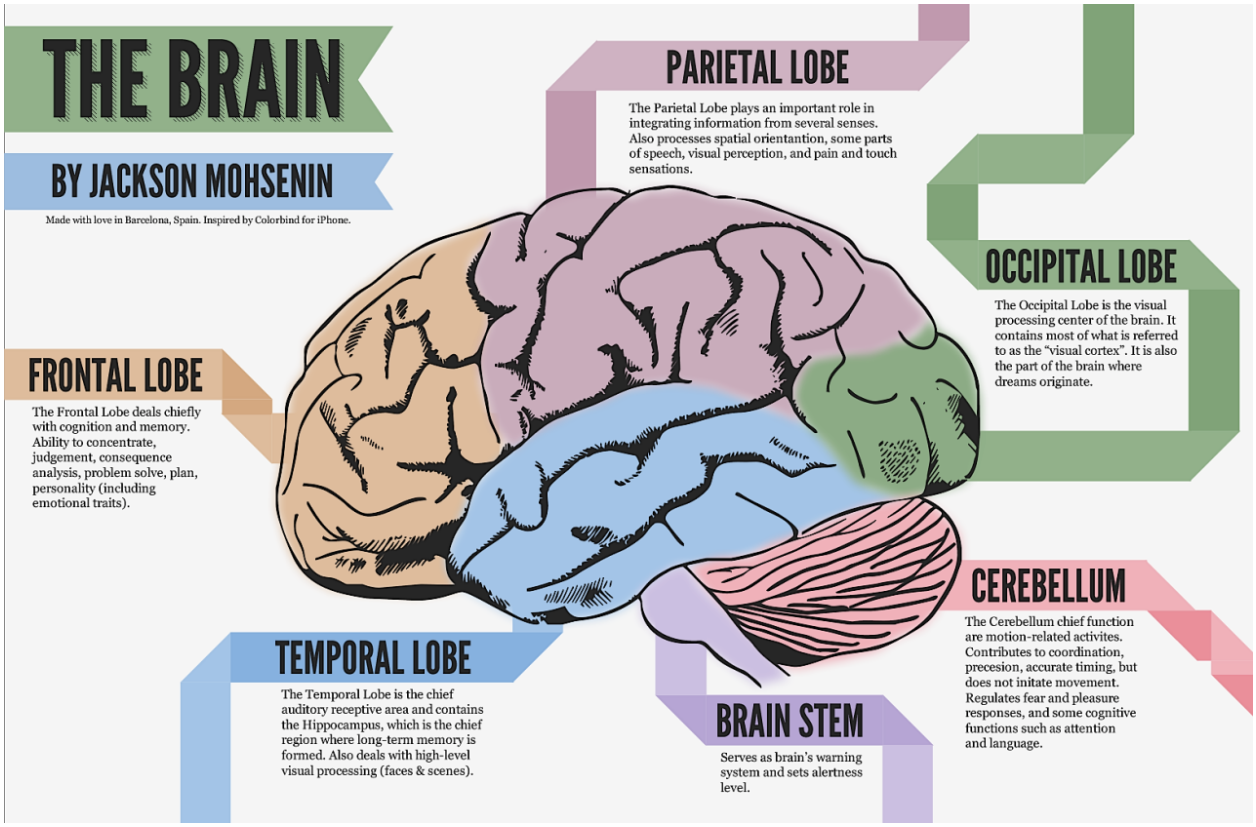
C) TEACHER CONTENT KNOWLEDGE (As a teacher, describe what you need to know regarding the concepts you've identified for each bullet above)

- The Central nervous system consist of brain, spinal cord, and nerves. It receives, processes, and responds to all physical stimuli.
- Five sense: Taste, touch, sight, smell, hear

<u>Brain</u>

- The brain has different parts.
  - Brainstem - regulates breathing, body temp, and heart activity
  - Cerebrum - Two hemispheres of the brain (right and left)

    - Cerebellum - controls balance
    - Hypothalamus - controls maintenance function like eating, linked to emotions
    - Hippocampus - linked to long term memory
- Four lobes.
    - Frontal - memory, judgement, problem solve, plan, personality
    - Temporal - auditory, contains hippocampus (long term memory)
    - Occipital - visual processing for brain, seeing, where dreams originate
    - Parietal - receives senses signals



Stroop Effect explained: since recognizing colors is not an "automatic process" there is hesitancy to respond; whereas, the brain automatically understands the meaning of words as a result of habitual reading. This idea is based on the premise that automatic reading does not need controlled attention, but still uses enough attentional resources to reduce the amount of attention accessible for color information processing. Stirling (1979) introduced the concept of response automaticity. He demonstrated that changing the responses from colored words to letters that were not part of the colored words increased reaction time while reducing Stroop interference.

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

Engage Portion:

- Brain Game PowerPoint

Explore Portion:

5 Senses Stations: sight, smell, taste, hear, feel

- Blindfolds (15 total)
- 5 sense worksheet (24)
- Pencils (24)

Taste:

- Lemon juice (1 bottle, we can use what's leftover in the food stuff bin)
- Dixie cups, or other small cups (48)
- Water
- Sugar (1 bag, what's leftover in food stuff bin)
- Salt (what's leftover in food stuff bin)

Touch:

- Faux fur (we will provide this)
- Sandpaper (1 square)
- Cooked noodles (we will provide these)
- Opaque (not see-through) Bowl (1)

Smell:

- Body spray (we will provide this)
- Vinegar (1 bottle)
- Coffee beans
- Cheese (we will provide this)
- Dryer sheet (we will provide this)

Hear:

- Audio of sounds of a:
    - Forest/campground
    - Beach
    - City
    - Rainforest
    - Amusement park

See:

- Various optical illusions
- 5 pieces of printer paper

Assessment Portion:

- worksheets (24)

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

https://faculty.washington.edu/chudler/hiro.html
http://classroom.kidshealth.org/3to5/body/systems/nervous.pdf
https://worksheets.edhelper.com/ReadingComprehension_29_56.html

https://www.optics4kids.org/illusions
https://docs.google.com/presentation/d/1mv0rPOGinue_zn6U7R7TijLBrSRiDbbSc9Y-qoPIVRI/edit?usp=sharing
Bill Nye -
https://www.schooltube.com/video/0a7e46b947444d71b0e8/Bill%20Nye%20Brain

F) TENTATIVE TIMELINE (Keep brief)

9:20am Hello! Greet Parents and Kids Enthusiastically
Sign-in and Get Name tags
ALL

9:40am Welcome to Saturday Science (for the last time)!
Reiterate Expectations
Introduction to Theme (How do I work?) and today's topic (Central Nervous System)
Brain test game - Stroop Effect

10:00am Brain Hieroglyphics

10:30am Bathroom/Snack Break - Bill Nye **(15 minutes long)**

10:45 am Five Senses Stations

11:30am Review from past 4 weeks
Assessment

12:00pm Clean-up and Parent Pick-up

G) DESCRIPTION OF YOUR LESSON:

ENGAGE

Focus Question: What does the central nervous system do for our bodies?

To engage the students we will test their brains by having them read colors, but say the color that the word is written in. This is the Stroop Effect.

1. Remind students what body systems we've learned about so far (circulatory, digestive, musculoskeletal, respiratory). Ask if anyone has any guesses about what

system we're learning about today (central nervous!) We are going to learn what our central nervous system does for our bodies.

2. Ask students *what they can tell you about the central nervous system. What does central even mean?* (the center, the main part, control center). *Exactly, the central nervous system is like the control center for our body. It processes all the information we receive and tells your entire body what to do. What are things you think your brain "tells" you to do, without you even thinking of it?* (breathing, processing the 5 senses, blinking, how we move our tongue when we speak, regulating our body temperature, sneezing, laughing). *Our brain does so much without us telling it to!*
3. *You're going to learn so much more about the central nervous system as the morning goes on, but for now we're going to play a brain test game.*
4. Pull up the Powerpoint
5. *We're going to show you several words, and we want you to try and say the color of the word, rather than read the actual word.* Instruct students to pay attention as you do an example.
6. Do 1 simple practice.
7. Have students do the activity within their groups. Words will be displayed on the board and each person in the group with try to say the color of the word. If students finish quickly, tell them to repeat the activity but try to say the color of the words as fast as they can!
8. Move to the next slide and ask the class the question: *why does our brain struggle with this? What do you think?* (actual answer: our brain is able to read words faster than it is able to think of the color of a word. Reading words comes more natural to us because we read all the time! We don't spend nearly as much time identifying colors as we do reading.)
9. *So, what else is going on inside our brains? A lot! We will examine this further…* (rhetorical question)

EXPLORE

Brain Hieroglyphics:

1. Ask students if they have heard of hieroglyphics.
2. If no one knows explain. (They are a way of communicating through pictures.)
3. Explain that we are about to look at hieroglyphics related to the brain. It is the students job to try and figure out in their groups what each hieroglyphic means.
4. Show them the powerpoint.
5. Do the first example with the students.
6. Have students work together to try and translate the remaining hieroglyphics.
7. After all the hieroglyphics have been translated, have students come up with their own hieroglyphics for each of the 5 senses. (Taste, touch, hear, sight and smell)
8. After everyone has done this, share with the class and discuss.

5 Senses Stations:

1. Set up the stations (make sure students don't see the materials!)
2. Give each student a worksheet and a pencil.

3. Tell students, *we're going to do a station activity where we explore our 5 senses. The worksheet we have given you will help you write down or draw your findings as you go through each station, so make sure to spend time writing down your answers at each station! You'll have about 7 minutes per station. Have fun!*
4. Split students into 5 groups. There will be 5 stations set up at the lab tables. Direct groups where to start.
5. 5 sense stations:
    a. Taste - Blindfold students and have them taste something and describe it
        i. Lemon juice, water, sugar, salt
    b. Touch - Blindfold students and have them feel inside a bin and try to describe what they feel
        i. Faux fur, sandpaper, cooked noodles
    c. Hear - play audio from different locations and have students guess where they are based on the noises they hear
        i. Forest/campground, beach, city, rainforest, amusement park
    d. Sight - have students look at optical illusions and describe what happened when they looked at them
        i. Optical illusions powerpoint
    e. Smell - Blindfold students and have them guess/describe the smells
        i. Body spray, vinegar, coffee beans, cheese, dryer sheet
6. Each group will rotate through the stations, complete the exploratory activities, and document their findings on their worksheets (7 minutes per station)
7. After everyone has completed each station, we will re-group as a class and have a discussion (explain portion of the lesson)

EXPLANATION

Overall Explanation:

1. Move your fingers, arms and legs, just like you're dancing. Scratch your head. Yawn. Think about what you want to eat for snack today. Count to ten, let's do it all together out loud. Now think about your favorite TV show, what is it? So all of the things we just did, your nervous system lets you do all of this and more.
2. All together there are three parts to your nervous system, can anyone tell me what they are? (the brain, spinal cord, and nerves.) Great!
    - Can anyone tell me where you find your brain? The brain is found inside your head.
    - Can anyone tell me where your spinal cord is? The spinal cord is inside your backbone.
    - Can anyone tell me where your nerves are? They're found ALL OVER YOUR BODY!!!

3. Your brain is the overall control of all things that happen in the body. It's in charge of making your body function without you even needing to think about it! Some people think of the brain like a principal in a school. Others think of the brain like a computer but even more complicated. Some people think of the brain like a government that runs a large city. What does the brain's job remind you of?

Brain Hieroglyphic Explanation:

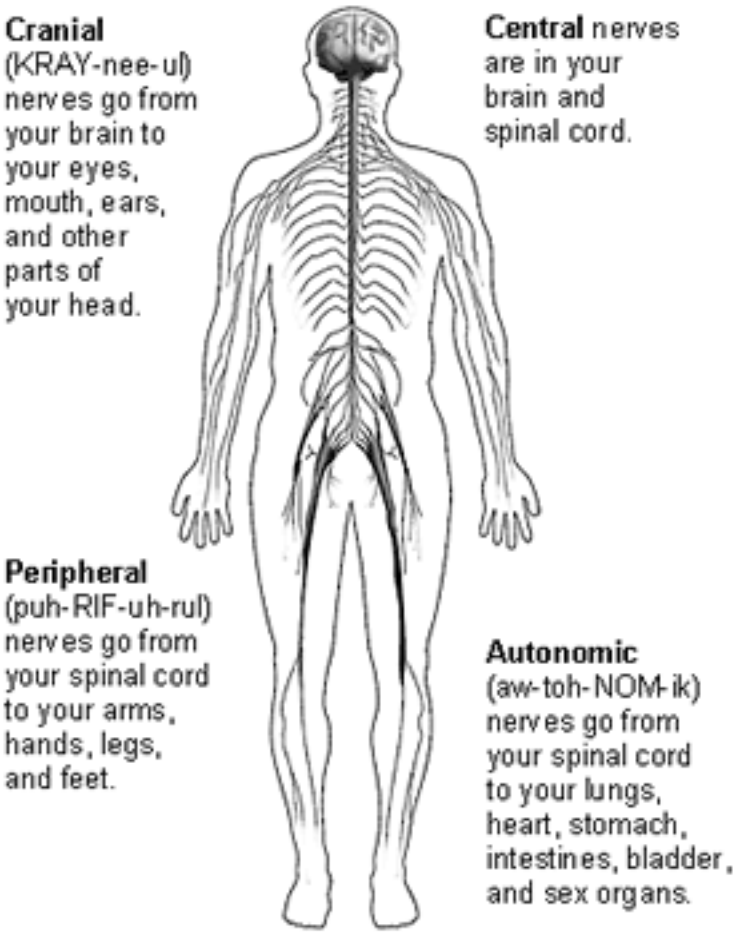
1. We will start off the discussion by asking:
    a. Was it easy or hard to translate the hieroglyphics?
    b. Why or why not?
    c. How do you think your brain helped you during this activity? (Prior knowledge, read words as a whole and not individual letters)
    d. Do you think this is an easier way to communicate instead of speaking?
    e. What could be some benefits to only communicating using pictures? (No language barrier)
2. Talk about the examples they came up with to represent the 5 senses.

5 Senses Station Explanation:

1. We will start off the discussion by asking:
    a. *What role did your brain play in the stations?*
    b. *How did it help you form your guesses for the different stations like touch, smell, hear, and taste?* (Prior experiences)
    c. *Did any of you guess the right answer? What made you guess that?*
    d. Show this image: *Our brain can receive multiple pieces of sensory info at once, and it processes each of them differently! Sometimes, we can't process all the information our brain receives from our senses at the same time. So our brain decides for us what is okay to "block out" and what isn't!*
    e. Play this video to demonstrate how our brain blocks out information it doesn't think we need to see anymore.
    f. *The brain does this selection of info quietly, in the background, helping to filtering out the things we're not focusing on, so that we can concentrate on the more important tasks that we do need to focus on.*

ELABORATE

For our lesson we are just touching on the brain and not going too in depth, but if necessary we will talk about the different kind of nerves in your body and where they are located. There are two kinds of nerves: peripheral nerves and autonomic nerves.



H) What will you do to learn if your students met the objectives for this week? (FORMATIVE ASSESSMENT - the 5th "E")

- We will give students a worksheet that has five boxes to represent the 5 lessons/body systems we have taught. Students will draw a picture of a major body part/organ inside each box that has something to do with the body system they're writing about. They will write the name of the system next to the picture (we have provided these names in a word bank) and then they will write 1 thing they learned about each system below the box! We will use this worksheet to assess what students have taken away from these 5 weeks together.

I) PEDAGOGICAL FOCUS:

<u>Assessing for learning:</u>
In our five senses activity we provide opportunities for students to write their answers as well as draw their guesses on the worksheets we which will provide to them. This provides equity to ELL students as well as others who are more visually oriented an opportunity to express themselves and their knowledge.