Saturday Science Teaching – Spring 2018

LESSON #1 Respiratory System

4th and 5th Grade

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

Learning Objectives:

1) Developing a familiarity with the respiratory system.
    a) What path does the air take through the body? How does the air get from outside the body and into the bloodstream? What "comes in" to the body and what "goes out" of the body?
    b) What structures are involved in the respiratory system?
    c) Model lung building activity in groups and have students draw out the respiratory system on a piece of butcher paper (hold up to someone to show where it is in the body).
2) Learning about the various volumes of air intake available through lung volume and lung capacity.
    a) How does lung capacity vary by sex? How does it vary according to physical activity background? Have students record their comparisons.
    b) Balloon activity.
3) How does physical activity affect the respiratory system?
    a) Counting exhalations (breaths/minute) while sitting and then after running around in the hall for a set amount of time.
    b) Measure time it takes for the breathing to revert back to resting pattern after exercising.

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

- What science and engineering practices are you addressing in this lesson:

3. Planning and carrying out investigations

4. Analyzing and interpreting data

6. Constructing explanations

7. Engaging in argument from evidence

- What cross cutting concepts are you addressing in this lesson:

2. *Cause and effect:* Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

4. *Systems and system models*. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering

6. *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. 7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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

We will need to know the structures in the respiratory system and how they work as well as volumes of air intake and its relationship with sex and amount of physical activity (be able to understand the points made in part A)

1) Structure and function of the respiratory system in the body
2) Lung capacity
3) Effects of exercise on the body, respiratory adaptation to exercise

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

Assuming 24 students - 6 groups of 4 students

- ❑ 24 lengths of string 2 ft long

- ❑ meter stick/ruler/measuring tape
- ❑ 12 empty two liter bottles
- ❑ 1 -2 rolls duct tape
- ❑ 48 balloons
- ❑ 24 bendable straws
- ❑ Enough to plug 12 2-liter tops with molding clay
- ❑ 6 Stopwatches

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

Balloon Activity:

- ❑ https://www.lifescitrc.org/resource.cfm?submissionID=4283
  - ❑ The handout is the pdf at the top of the above link^

Lung Model:

- ❑ http://thefantasticfive-hockmana.blogspot.com/2014/05/breathe-in-breathe-out-respiratory.html

F) TENTATIVE TIMELINE (Keep brief)

8:30 am - 9:30 am: Set up

9:30 am - 9:40 am: YouTube video of skaters getting out of breath

9:40 am - 10:00 am: Respiration activity

10:00 am - 10:30 am: Balloon activity, data collection, interpretation, and discussion

10:30 am - 10:45 am: Snack

10:45 am - 11:00 am: Discuss the respiratory system

11:00 am - 11:40 am: Lung model building activity

11:40 am - 12:00 pm: Labelling Race

G) DESCRIPTION OF YOUR LESSON: Learning Cycle (Engage, Explore, Explanations, Elaborate)

1) You will **ENGAGE** the students into the activities for the day (Crystal Tyler) Students will watch the following video and be asked to observe the changes in the athletes breathing patterns.

Activity: Youtube video of skaters getting out of breath:
https://www.youtube.com/watch?v=CZtxUAXypl0

Teacher will propose the focus question and ask students to think about the focus question throughout the days' activities.

Focus Question: How does physical activity affect the respiratory system?

Students will be in six groups of four students each. Students will choose a team member to measure respirations on, a student to keep time on the stopwatch, a student to count respirations(how many times the student's chest rises), and a student to record data on the table on the board. Timekeeper student will set 1 minute on the timer, while counting student counts how many times the student's chest rises, while they are sitting still. The recorder will record this number on the table on the whiteboard. Then the student will go down to the first floor with an adult and run up to the third floor and back to the classroom. Then the group will measure the student's respirations per minute again and record the data on the board. Then they will time how long it takes for the students' breaths/minute to return to resting state.

-Then students will record this data on the whiteboard in a chart (resting, after activity, recovery) for each group.

Group Number	Respirations/ Per Minute Resting	Respirations/Per Minute After Activity	Respirations/Per Minute Recovery
1			
2			
3			
4			
5			
6			

-ask them questions to get them to see patterns in the data

2) The students will **EXPLORE** the concept through gathering data/investigating/experimenting etc (Ashley Anderson)

Each child will receive a balloon and make predictions of whose balloon will be blown up the biggest and why (does gender matter? Does exercise matter? Body size?) using a normal breath. First, the students will sit and breathe, concentrating on how much breath comes out when they are breathing normally (normal inhale/normal exhale). Have the students blow up their balloons then use the string to measure circumference on the third try. They should record/make note of the lung capacity difference for boys and girls, note exercise, and other potential factors.

They will then repeat this experiment doing large inhale/normal exhale (like a sigh), normal inhale/large exhale, and large inhale/large exhale. Fill data into chart below (it will be drawn up on the whiteboard, teacher will write in data!). Be sure to discuss data and what it means, leading into the structure of the respiratory system!

Name	Normal Inhale/Normal Exhale	Big Inhale/Normal Exhale	Normal Inhale/Big Exhale	Big Inhale/Big Exhale
Student 1				
Student 2				

3) You will support students in making sense of the concepts through forming **EXPLANATIONS** (Katherine Shanahan)

Teacher resource: http://www.teachpe.com/anatomy-physiology/the-respiratory-system-breathing/

A. Introduce students to the structure and function of the respiratory system
    a. First, ask students what they think that the respiratory system does. What does this system help the body to do? Is it essential to living, exercising, etc.?
    b. Based on responses, explain the main functions of the respiratory system:
        i. To transport air to the lungs (inhaling and exhaling)
        ii. To diffuse oxygen to the bloodstream
            1. Does anyone know what diffuse means? What are some other words to describe that process? (Maybe disperse, deliver, spread see what they say)
            2. When and where does this happen? (When air is **inhaled** into the system)
        iii. What happens when you exhale? What are you exhaling and where does that come from?

1. See what they answer and then make sure to tell them that the respiratory system gets carbon dioxide from the bloodstream and this is what's **released in an exhale**.

c. Rephrase the function of the respiratory system in relation to what they just learned:
   i. What are oxygen and carbon dioxide in the context of breathing? (They are gases!) - if you think of it in states of matter
      1. Keeping it simple - so the main function of the respiratory system can be said to be a **gaseous exchange** (alveoli - so let's see where these aveoli are located)

B. Familiarize students with the main parts of the respiratory system.

C. (patriecejhayes.weebly.com)

a. Distinguish that there are both **upper** and **lower** tracts. Ask students if they can guess what parts are in which tract referring to a non-labeled simple diagram pre-drawn on the board.
b. Draw out the diagram of the respiratory system (included in the resources) on the board and label it for the students to see.
c. Ask students to think about this diagram in relation to what they saw in the YouTube video.
   i. How do the athlete's lungs move if they are breathing fast? Slow?
   ii. Do you think someone could take in more air/deeper breaths if they exercised regularly or didn't? If they were a man or a woman? Why?

1. **You have a fixed lung capacity as a man or a woman (men can breathe in more air). The volume of air that you intake will not change with physical activity, but the efficiency of the respiratory system will increase.**

iii. This should lead them into the lung building activity...

D. Set students up to participate in the lung modeling activity.
   a. Ask students now that they've seen a labeled diagram, what they think helps someone to breathe. (Muscles!)
   b. Breathing has to do with changes in pressure and muscle contractions.
      i. Ask the students to take a deep inhale and note what their lungs feel like. Now take a deep exhale and note what their lungs feel like. Write the observations on the board.
      ii. State that when inhaling, the lungs expand outward while the diaphragm contracts and moves down (maybe draw a simplistic diagram on board). Intercostal muscles make the lungs move up and out.
      iii. When the lungs expand, there is more room. More room = less pressure. Air rushes into the lungs on an inhale to equalize the pressure.
         1. If it seems like a good idea, could talk about molecules in an expanding/contracting box to help them think about pressure.

E. Let's see all of this in action! Complete the lung activity!
   a. Note: Should I explain how breathing works before the activity? Or let them explore and then explain after?
   b. Ask what the structures represent (bottle is the diaphragm/rib cage, top of straw = mouth, straw body = trachea, bendy straw part = bronchi).
   c. Have students blow into the straws and see the lungs expand, collapse the bottle and see it contract.

F. Wrap-up discussion and lead into next activity.

4) Students will have an opportunity to **ELABORATE** on what they've learned this week and **Evaluate** the students through this assessment (Kelsey Haley)

Labeling race: label the parts of the respiratory system in groups (this also helps to check their understanding/what they've learned from the activities)

a) Students (in their 6 groups of 4) will sit with their groups at tables
   i) Each group will be given a blank respiratory labeling worksheet and a word bank on little post its.
   ii) The students will work together in their groups to label the different parts of the worksheet.
   iii) The first group that finishes the worksheet correctly is in first place for that week and therefore wins 6 points.
      1) 6 points

2) 5 points
3) 4 points
4) 3 points
5) 2 points
6) 1 point

*We will have been keeping track of the points for any competitive aspects of the future lessons. At the end of saturday science each group should win some sort of prize.

5) **EVALUATE** What will you do to learn if your students met the objectives for this week?

The summative evaluation for this set of activities will be the completion of the labeling race where students will demonstrate their understanding of the different parts of the respiratory system.

Formative evaluations will be spread throughout the lesson sections when leads ask students to clarify/explain their understanding.

I) PEDAGOGICAL FOCUS: Productive Discussions!

-Explain how you are trying to incorporate this into your practice in this week's lesson

ENGAGE

1) Anticipate
    a) Figure out what patterns students might see in the breaths/minute data between resting, activity, and returning to the resting state
    b) Draw up a model chart of how the data should be recorded on the whiteboard
    c) Figure out student groups (mix by sex?)
2) Monitor
    a) Facilitate the data collection
    b) Ask questions based on the students' observations
3) Select
    a) Choose a group or two to talk about findings out loud to the large group
4) Sequence
    a) Choose the order students talk about their findings
5) Connecting
    a) Reiterate the patterns they found and how this might relate to lung capacity

EXPLORE

6) Anticipate

a) Figure out what patterns students might see in the lung capacity data between the different sexes and different amounts of physical activity
b) Draw up a model chart of how the data should be recorded on the whiteboard
c) Figure out student groups (mix by sex?)

7) Monitor
   a) Facilitate the data collection
   b) Ask questions based on the students' observations
8) Select
   a) Choose a group or two to talk about findings out loud to the large group
9) Sequence
   a) Choose the order students talk about their findings
10) Connecting
   a) Reiterate the patterns they found and lead into the discussion of the respiratory system

EXPLAIN

11) Anticipate
   a) How students might be inclined to label the parts of the respiratory system, is anyone able to identify the main parts right off the bat?
   b) Come up with ideas of how students might think about air path
   c) Anticipate what students think enters the lungs and what leaves the lungs (note they may not say that we exhale anything other than oxygen)
12) Monitor
   a) Walk around during the lung modeling activity asking students to elaborate their understanding about breathing and how their lungs work
   b) Note differences/similarities in activity approaches/understanding between groups
13) Select
   a) Select certain groups to share their lung models/explain them to the rest of the groups
14) Sequence
   a) Make sure that groups are being picked with potentially contrasting understanding/different approaches and ideas
15) Connecting
   a) Maybe hint at how the structure and function relates to the previous activities (exercise affects, lung capacity)

ELABORATE

Lead Teacher: Kelsey Haley

16) Anticipate
   a) Some students may not understand every section of the human respiratory system.

b) Some students may not work well together in their groups.

17) Monitor
    a) Watch the groups to make sure students are working well with each other.
    b) Help students by providing helpful hints of where some body parts are located.
18) Select
    a) Make sure the students know when they have completed the labeling correctly.
19) Sequence
    a) Make sure that past groups are good at working with each other.
    b) Any changes in groups could be made during this time to solve any student to student relations.
20) Connecting
    a) Bring what they have learned from this activity back to the discussion during the explanation section.
    b) The functions and characteristics of the different body parts.

Handouts

Used for Elaborate

Respiratory Physiology Activities

Purpose: Explore the various volumes of air that go in and out of the lungs.
Materials: round balloons, string, and measuring tape or ruler

Activities: NOTE: Please do not do this activity if you have respiratory difficulties or asthma.

A) Sit quietly, concentrating on how much air moves in (inspiration) and out (expiration) during your normal breath. At the end of a normal inspiration, blow into the balloon the same (approximate) amount of air you normally breathe out. Practice this once or twice. Rest for a minute between trials so you don't feel lightheaded. On the third time, measure the circumference of the balloon at its widest point, using the string and the ruler. Write your answer here.	
B) Repeat A) but this time, take a deep inspiration before you start. Try to exhale only to the extent that you normally would. This is like a big 'sigh' you might do occasionally. Again, after you practice this, measure the balloon. Write your answer.	
C) Repeat A) but this time, from a normal inspiration, breathe into the balloon as much as you can in one breath. Practice first, then do it and measure the balloon. Write your answer here.	
D) Repeat the process in C) again. This time take a deep inspiration before you start and then breathe into the balloon as much as you can. As before, practice first then do it again and measure the balloon. Write your answer here.	
E) Stand up and repeat D) again. Write your answer here.	

Outcome: The size of the balloon should increase progressively from A) to E).

Background and Significance: This activity illustrates the various 'volumes' of the lung and how they change. The activities above demonstrate, respectively, A) normal tidal volume; B) respiratory reserve volume, C) expiratory reserve volume, and D) total lung volume, as measured while sitting. The volume in E) reflects the effects of standing on facilitating filling and emptying the lungs with air.

Questions for Group Discussion:

- What are the respective volumes measured?
- How do lung volumes compare with others in your group?
- Which increases lung volume more – deep inspiration or deep expiration?
- How and why does exercise cause breathing to increase?
- If you got 'light-headed' during this activity, how can it be explained?

* Activity presented by Steven S. Segal, Ph.D., Yale University School of Medicine, at the Experimental Biology '99 workshop for teachers and students, Washington, DC.

Q405/E548 Saturday Science Teaching – Spring 2018

LESSON #2 Cardiovascular System

4th and 5th Grade

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

Learning Objectives:

1. Develop familiarity with the cardiovascular system.
    a. To help students understand how the heart works and what its function is in the cardiovascular system.
        i. The construction of the blood vessel model and heart pump model will allow students to explore how parts of the cardiovascular system functions.
    b. Students should become familiar with the key parts of the heart.
        i. This will be explored through anatomically correct valentine making and assessed through the heart word game at the end of the lesson.
    c. Students should learn the role of the cardiovascular system in moving blood/oxygen throughout the body.
        i. This will be explored in the dramatization of blood movement activity.
2. Have students investigate how the heart rate responds to physical activity.
    a. Engage in an activity counting the heartbeats per minute for rest, standing, and after exercise. Measure this with the real stethoscopes to get data.
        i. What happens internally when heartbeat increases?
    b. The students will use paper towel rolls to listen to heart beats and compare that to how it sounded with real stethoscopes.

For both of the learning objectives above, we will use the think-pair-share method to make sure that the learning objectives are being met.

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

- What science and engineering practices are you addressing in this lesson:

3. Planning and carrying out investigations

4. Analyzing and interpreting data

6. Constructing explanations

7. Engaging in argument from evidence

- What cross cutting concepts are you addressing in this lesson:

2. *Cause and effect:* Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

4. *Systems and system models*. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering

6. *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. 7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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

The ability to identify the key structures of the heart (aortic artery, pulmonary artery, left/right ventricle, left/right atrium)

The flow of blood throughout the body leaves lung -> pulmonary veins-> left atrium-> left ventricle-> aorta-> heart arteries/body arteries-> Body veins->superior/inferior vena cava-> right atrium-> right ventricle-> pulmonary trunk-> pulmonary arteries-> returns to lungs

Artery-> Oxygen-rich blood moves away from the heart

Vein -> Oxygen-depleted blood moves towards the heart

The strength and speed of heart contraction affects how much blood comes out. Quicker contractions = more blood, stronger contraction = more blood.

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

Assuming 24 students - 6 groups of 4 students

- Trays for materials (6)

- Alcohol Wipes (at least 24), to wipe stethoscopes
- Pulse detector (building with clay and toothpicks) (MAYBE)
    - ❑ quarter sized clay piece (6 pieces)
    - ❑ toothpicks (6)
- Blood vessel model
    - ❑ bulb syringe (12)
    - ❑ balloons (12)
    - ❑ plastic cups (12)
- Heart pump model
    - ❑ clear mason jars (plastic)? Medium sized (16 oz?) (24)
    - ❑ regular sized balloons (24)
    - ❑ red food coloring (1 bottle)
    - ❑ scissors
    - ❑ bendy straws (48)
    - ❑ tape
- Building a stethoscope
    - ❑ Paper towel tubes (12)
    - ❑ Real stethoscopes (however many we have)
- Dramatization of blood movement
    - ❑ Masking tape
    - ❑ Index Cards
    - ❑ markers
- Valentine making
    - ❑ Crayons
    - ❑ markers
    - ❑ Scissors
    - ❑ Poster board pieces
    - ❑ Glue Sticks
    - ❑ https://homeschoolclipart.com/wp-content/uploads/2014/06/HeartLarge.gif
    - ❑ http://image.shutterstock.com/z/stock-vector-happy-valentine-s-day-card-with-real-heart-typography-ribon-arrow-be-my-valentine-170863241.jpg

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

Heart Pump:

- ❑ https://www.kiwico.com/diy/Science-Projects-for-Kids/3/project/Heart-Pump-/2739

Circulatory System Experiment:

- https://study.com/academy/popular/circulatory-system-experiments-for-kids.html

Dramatization of the Blood's Trip Through the Body:

- http://www.henry.k12.ga.us/cur/mybody/circ_lessons.htm

Heart Word Game (Assessment):

- http://www.heart.org/idc/groups/heart-public/@wcm/@global/documents/downloadable/ucm_312359.pdf

More Information

- https://www.stem.org.uk/resources/elibrary/resource/35233/human-body
- http://www.sportsdoctor.com/articles/physiology2.html
- https://www.verywellfit.com/winter-olympic-sports-training-3120121
- http://www.heart.org/HEARTORG/Educator/FortheClassroom/ElementaryLessonPlans/Elementary-Lesson-Plans_UCM_001258_Article.jsp#.WnolQUdOmfD

F) TENTATIVE TIMELINE (Keep brief)

8:30 am - 9:30 am: Set up

9:30 am - 9:40 am: Video/Intro to the day/Propose focus question

9:40 am - 10:10 am: Stethoscope Activity with physical activity, build your own stethoscope

10:10 am - 10:40 am: Heart pump / blood vessel model activities

10:40 am - 10:55 am: Snack

10:55 am - 11:30 am: Dramatization of blood flow

11:30 am - 11:40 am: Word game

11:40 am - 12:00 pm: Create your valentine

G) DESCRIPTION OF YOUR LESSON: Learning Cycle (Engage, Explore, Explanations, Elaborate)

1) **ENGAGE** (Kelsey)
   a) **Focus Question:** How does physical activity affect the heart?

i) Teacher will propose the focus question and ask students to think about the focus question throughout the days' activities.

Students will watch the following video and be asked to hypothesize what is happening inside of the athletes body.

Activity:
Youtube video of:
https://www.youtube.com/watch?v=ke0iusvydl8&t=88s

Questions for Discussion:

- Do you think that the athletes heart is beating faster before they start skating or after.

Why? Answer: The heart beats faster so that the muscles can get more oxygen so that they move.

True or false:The heart is a muscle? TRUE

What tool can we use to hear the heart?...Stethoscope

Activity: All of the students will follow a video that allows the students to exercise and elevate their heart rate. (Only one student will be measured)
YouTube Video: https://youtu.be/g3L556EpRuo

Groups: Students will be in 6 groups of 3. Students will choose a team member to **record** heart beats, **count** the heart beats, and a student to **perform** the activity.

Recorder: will record the number of heartbeats per minute on the table on the whiteboard.

Counter: This person will count the number of heartbeats per minute using the stethoscope. student will set 1 minute on the timer, while counting student counts how many times the student's heart beats, while they are sitting still.

Performer: This person will do the activity.

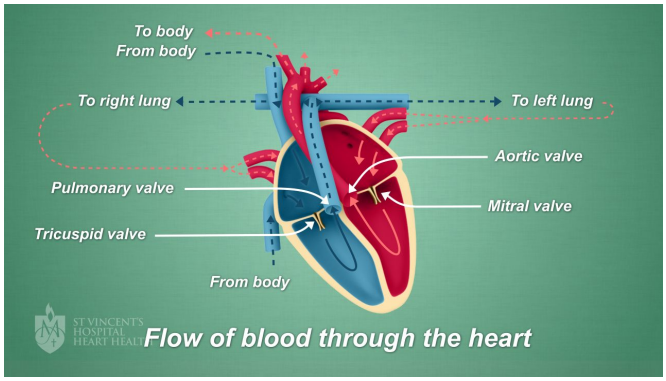
Group Number	Heartbeats per minute (resting)	Heartbeats per minute (active)
1	79	174
2	63	106
3	77	82
4	38	70

5	47.5	74.7
6	96	115
7		
8		

After the Data: ask them questions to get them to see patterns in the data

2) The students will **EXPLORE** the concept through gathering data/investigating/experimenting etc (Kat)

A. Students will familiarize themselves with the structure of the heart. To introduce the main heart parts, students will be shown a 2 min YouTube video (https://www.youtube.com/watch?v=JFSF9n0zu18).
B. Each student will be given a blank heart diagram with a word bank at the top. After watching the video, students will be given time to label the diagram -- they could work with their neighbors if they would like.
    a. While students are labeling, teachers will walk around to answer questions/help out and monitor their conversations.
    b. When everyone looks like they are finished, the teacher will ask a student or two to walk her through the labels of a diagram projected on the board.
        i. After engaging with the labeling activity, do you feel like you better understand the parts of your heart? Why or why not?
C. Before the model building activities, we will go over the pathway blood takes through the heart -- for this, student will use the diagram that they labeled.
    a. Students will each get two different colors of crayons and will be asked to use one color to represent blood flowing to the heart and one color to represent blood flowing out of the heart.
    b. What path do you think the blood takes through the heart? Where does the blood enter and where does it exit? What is the difference between the blood coming into the heart and the blood flowing out of the heart (arteries carry oxygen-rich blood away from the heart, veins carry oxygen-depleted blood to the heart)?



c.

d. As a group we will go over the blood flow path in the heart and color the path in a different color than the path out.

D. The first activity will be the heart pump activity. We figured that each student would want to make their own to take home. Necessary materials will be given to students on a tray.
   a. First, students will stretch the top half of a pre-cut balloon over the top of the plastic mason jar with red-colored water in it. Instructors should walk around and make sure that the kids are getting the balloon to lay flat when stretched.
   b. Next, the educator at each table will help the students cut two small holes, about one inch apart, in the stretched balloon using scissors. Two bendy straws will then be stuck into the holes. The balloon needs to be tight around the straws so that no air escapes!!! Otherwise the pump won't work :(If the hole is too big, students can use tape to patch it and tape the straw to the balloon.
   c. The last and final prep step is taping one of the straws shut. It doesn't matter which straw, students just need to make sure that the opening is securely taped so that no air escapes.
   d. Now the teacher will ask students to put the model on their trays and use their fingers to push down between the straws.
      i. What happens when you push down hard? What about when you push a little softer?
      ii. Pushing down is analogous to the heart muscle contracting -- the larger the contraction, the more blood that is pumped.
         1. These contractions move the blood from the heart chambers (mason jar) out through the arteries (straws). This happens 70 times a minute on average.
         2. Notice that the blood vessels are missing from this model….

E. Lastly, students will build a small-scale blood vessel model! The main purpose of this activity is to help students visualize how blood vessels expand and contract. **Note that veins are blood vessels and that they carry blood back to the heart from the body.**
    a. For this activity, we will have student work in pairs so the instructor should ask the students to partner up at their tables. A tray with necessary materials will be distributed to each of the pairs.
    b. Students will fill the bulb syringe or pipette with water. After it is filled, one student should hold onto the syringe while the other puts the balloon over the end.
    c. Each student should try to squeeze the syringe (empty water into the balloon) and then release it (water flows back out of the balloon). This is supposed to show the contraction and expansion of blood vessels as the heart pumps.
        i. This allows the blood vessels to regulate the amount of blood that flows into parts of the body at a given time.

3) You will support students in making sense of the concepts through forming **EXPLANATIONS** (Crystal)

First watch this video:

https://www.youtube.com/watch?v=-s5iCoCaofc

Dramatization of the blood's trip through the heart

- We will label parts of the room as parts of the body
- Students will be assigned the roles of "body organs and parts," (ex. heart, lungs)
- Other students will act as the "blood." These students will have tags labeled "oxygen" and will travel from the heart to the lungs, then back to the heart and other parts of the body. As they travel, they will exchange "oxygen" tags for other tags labeled "carbon dioxide" and "other wastes."
- When the oxygen is used up, the "blood" then must travel back to the heart and lungs to exchange the "carbon dioxide and waste" for new "oxygen."

4) Students will have an opportunity to **ELABORATE** on what they've learned this week and **Evaluate** the students through this assessment (Ashley)

The students will complete the word game to demonstrate their understanding of the different parts of the cardiovascular system, specifically the heart and how the cardiovascular system works. This is a crossword puzzle and will be a competition (the team that completes it the fastest will get more points). They will also make valentines of anatomically correct hearts to reinforce the concepts covered in the activities.

5) **EVALUATE** What will you do to learn if your students met the objectives for this week?

In engage, the students will be asked for formulate hypotheses before the activity begins, then perform think-pair-share after to describe how their views changed throughout the course of the activity.

The kids will also be asked to do think-pair-share during explore, and will be asked to correlate the models they are making to the actual cardiovascular system.

During explain, the kids will show understanding of the cardiovascular system through participation in the dramatization of the bloods movement through the heart. They will then perform the crossword puzzle and create the valentine's to further tie together the lessons. Completion of these activities as a competition (timed) will show their mastery.

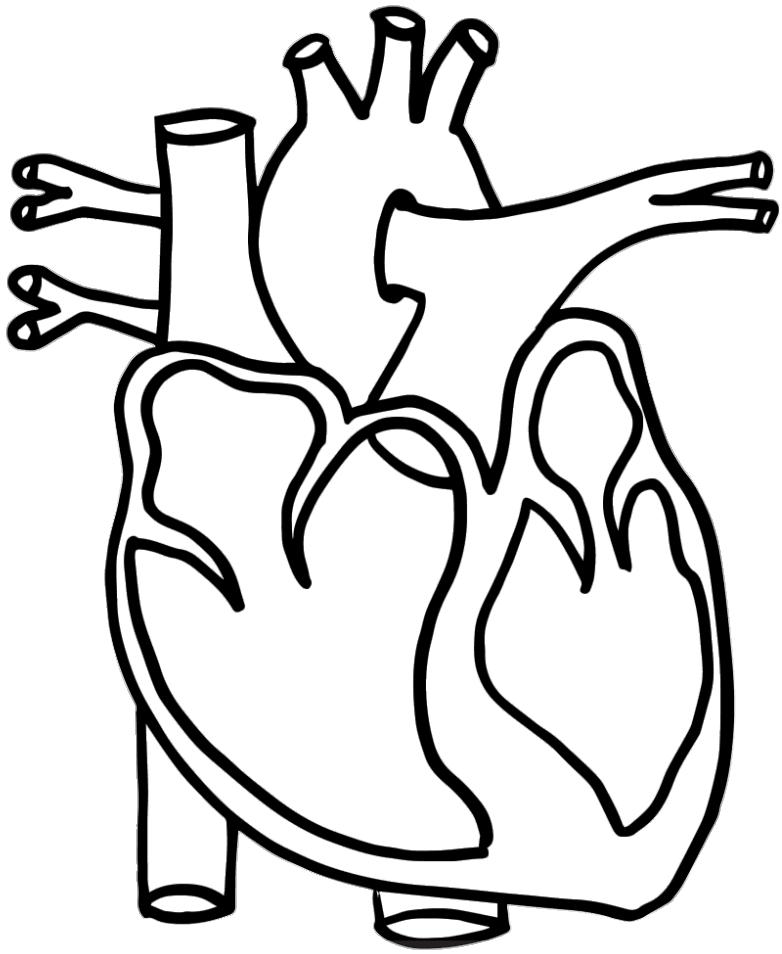
Overall, formative evaluations will be spread throughout the lesson sections when leads ask students to clarify/explain their understanding.

I) PEDAGOGICAL FOCUS: Science for all

ELL integration:

- Think Pair Share will be used for the engage portion of the lesson and parts of the lesson where students are building models/producing artifacts.
- We will be providing both a matching and fill in the blank assessment worksheet to wrap up the lesson.

Handouts

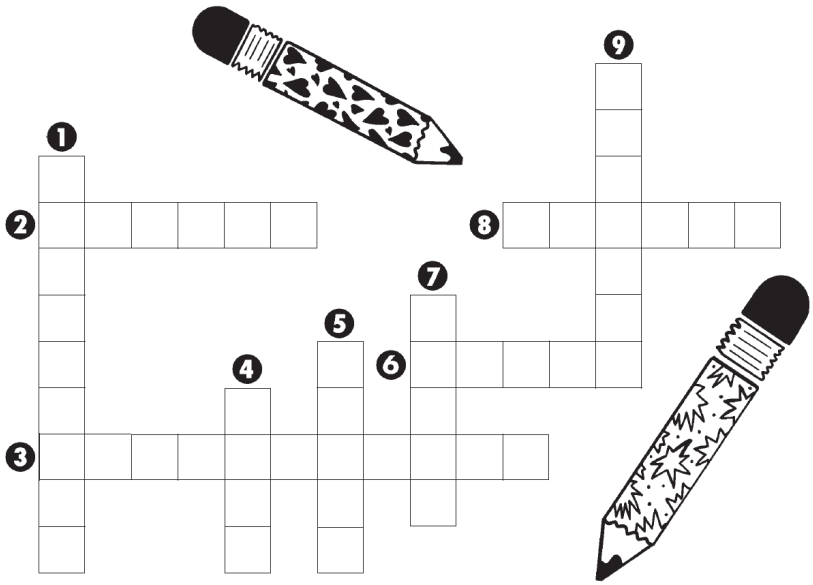


NAME _____

American Heart Association®
Fighting Heart Disease and Stroke

Heart Word Game

Sean and Yolanda were playing a game in which they spell words using letter squares. All the words they spelled were about the circulatory system. Fill in their game board by using the clues and words below.



1	what the heart does to send blood rushing out	**blood**
2	a gas that our bodies need	**circulatory**
3	the name for the system that includes our heart and blood vessels	**contracts**
4	what the heart works like	**heart**
5	what you can listen to with a stethoscope	**vessels**
6	the part of the body that takes in oxygen	**muscle**
7	the liquid that carries oxygen throughout our bodies	**oxygen**
8	what our heart is made of	**pump**
9	the tubes that carry blood	**lungs**

Q405/E548 Saturday Science Teaching – Spring 2018

LESSON #3 Building Muscle

4th and 5th Grade

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

Learning Objectives:

1. Develop an understanding of how muscles function in the body and why they are important for movement and physical activity.
    a. Introduce the types of muscle movements and muscle fatigue in "Engage"
    b. Explain stage, hand activity (tendons)
2. Become familiar with what types of muscles are used during certain types of exercises and olympic sports.
    a. Through completion of the Olympic activities in "Explore" and "Extend"

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

- What science and engineering practices are you addressing in this lesson:

3. Planning and carrying out investigations

4. Analyzing and interpreting data

6. Constructing explanations

7. Engaging in argument from evidence

- What cross cutting concepts are you addressing in this lesson:

2. *Cause and effect:* Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

4. *Systems and system models*. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for

understanding and testing ideas that are applicable throughout science and engineering

6. *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. 7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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

Homologous structure - an example of an organ or bone that appears in different animals, underlying anatomical commonalities demonstrating descent from a common ancestor.

Familiarity with muscles of the human arm (Deltoid, Biceps, Triceps)

Familiarity with the muscles of a chicken wing (Deltoideus, Biceps, Triceps, Extensor Carpi radialis, Flexor Carpi Ulnaris)

Tendon - a fibrous connection from muscle to bone.

Ligament - a fibrous connection between 2 bones.

Familiarity with the bones of the human arm/forearm and chicken wing (reference labeled pictures in "Handouts" section).

Types of muscle movements

- Isometric - length of the muscle does not change, but the amount of tension increases with contraction that is opposing the load.
- Concentric - the muscle length shortens during contraction, overcomes opposing resistance of the load.
- Eccentric - the muscle length lengthens due to tensions created by the load.

Muscle Fatigue - results from an imbalance in calcium ions and low ATP (energy levels), muscles begin to lose functionality (ability to contract).

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

Assuming 24 students - 6 groups of 4 students

Hand Crafting Activity - **(They will be taking this home with them)**

- ❑ Different colors of cardstock/construction paper (24 pieces)
- ❑ Bendable straws

- ❑ Scissors
- ❑ Thick thread or thin string (3 spools)
- ❑ Scotch tape AND duct tape
- ❑ Pencils

Muscle Fatigue Activity

- ❑ 24 “stress balls” (just need to be kind of hard, such as a tennis ball or wiffle ball)

Luge Building Activity

- ❑ Foam pipes cut in half (they are black and in the classroom, in the cabinets, to be used for a track)
- ❑ Marbles, at least 24
- ❑ Crate of blocks
- ❑ Aluminum Tubs (2)

Obstacle Course

- ❑ Styrofoam Skies
- ❑ Masking Tape (5 rolls)
- ❑ Pool Noodles (2)
- ❑ Plastic Grocery Bags (20)
- ❑ Peanut styrofoam (enough to fill 20 grocery bags)
- ❑ 6 meter sticks

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

Muscles Activity: https://www.stem.org.uk/resources/elibrary/resource/35233/human-body

Muscle Fatigue: https://www.lifescitrc.org/resource.cfm?submissionID=4282

Hand/Tendon Crafting: https://www.livinglifeandlearning.com/muscular-system-hand-craft-for-kids.html

What Types of Muscles are Used During Certain Events:

- http://www.besthealthmag.ca/best-you/fitness/10-winter-olympic-sports-and-the-muscles-they-use/view-all/
- http://www.businessinsider.com/the-body-shape-of-every-athlete-2014-2

Olympic Obstacle Course

- http://mrsbretzmusicroom.blogspot.com/2010/06/music-olympics-cross-country-skiing.html
- Possible Summer olympic integration: Noodle Throw.
- Possible Summer: Long Jump
- Speed skating with socks: https://www.realcoake.com/olympic-games-kids-families/
- Luge: use PVC pipe and work as teams to get a tennis ball or golf ball down the PVC pipe to the other end of the atrium. Create a track using your team : http://www.ventureteambuilding.co.uk/pipeline-team-building-activity/ GREAT TEAM BUILDING ACTIVITY
-

Winter Olympic lessons:

https://sharemylesson.com/blog/lessons-winter-olympics

F) TENTATIVE TIMELINE (Keep brief)

8:30 am - 9:30 am: Set up

9:30 am - 9:35 am: Skeleton video

9:35 am - 10:00 am: Engage: Questions/Muscle Fatigue Activity

10:00 am - 10:40 am: Exploration: Luge team building activity **(Will move to the Atrium)**

10:40 am - 10:55 am: Snack

10:55 am - 11:20 am: Explanation: Hand activity and Chicken Wing Demo

11:20 am - 12:00 pm: Olympic Obstacle Course **(Will move to the Atrium)**

G) DESCRIPTION OF YOUR LESSON: Learning Cycle (Engage, Explore, Explanations, Elaborate)

2) **ENGAGE** (Ashley)
   a) **Focus Question:** How do your muscles help you move, and how are they affected by physical activity?
      i) Teacher will propose the focus question and ask students to think about the focus question throughout the days' activities.

Video: https://www.youtube.com/watch?v=W8WDgnpvqdo&t=51s

Questions:

- What helps your body move? (muscles)
- Do you think the athletes were using their muscles? How? (tensing, any shift in weight would shift how they moved, could even make them go slower)
- How can you tell that your muscles are working? (have them move their arms in different ways, they can feel the pull)
    - What is it called when you make a statement based on this kind of **evidence**? (inference)
    - What we just did was collect **qualitative** data, we can all feel our muscles moving beneath our skin
- What are different ways that your muscles allow your body to move? (isometric, concentric, eccentric)
    - Isometric - length of the muscle does not change, but the amount of tension increases with contraction that is opposing the load.
    - Concentric - the muscle length shortens during contraction, overcomes opposing resistance of the load.
    - Eccentric - the muscle length lengthens due to tensions created by the load.

Then lead the kids through the muscle contractions activity. Each kid gets a ball (such as a tennis ball), they will grasp it and time how long they can until their muscles give up. Record data (average per table). Then rest a minute and repeat with the other hand. Then go back to the original hand, then the other hand. Compare all of the data and notice trends. (The second time the amount of time they are able to grasp will be lower, due to muscle fatigue)

Group	Dominant Hand (seconds)	Other Hand (seconds)	Dominant Hand Again (seconds)	Other Hand Again (seconds)
1				
2				
3				
4				
5				
6				

Then take averages and turn this into a bar graph!

This is **quantitative** data, meaning that it is represented in numbers!

Questions:

- Why do you think that we did this activity?
- Do you notice a trend from the data (the amount of time we were able to hold on decreased!)
- Why do you think you get tired after using your muscles? (muscle fatigue results from an imbalance in calcium ions and low ATP (energy levels), muscles begin to lose functionality (ability to contract))

Now that we are moving on to the next activity, be sure to take note of what muscles you are using and how they work together to allow your body to move. What kind of data will you be collecting? (**qualitative!**)

2) The students will **EXPLORE** the concept through gathering data/investigating/experimenting

Luge team building activity

How to be a team player: http://time.com/5142773/nigerian-bobsled-team-opening-ceremony-winter-olympics-2018/

The students will be split into two teams. Ask the students to find a buddy and then number them 1 and 2 to split them into two teams. Each team must work together to use the materials to create a track that can get one marble from one side of the atrium to the tub that is on the other side.

Phase 1: students will be given a shorter distance to accomplish the task.

Rules: No student may touch the marble, the marble cannot stop or fall off the track.

*If any of the rules are broken then the team much completely start over.

- ❑ Most common solution: Students will build a track using the materials that they are given.

Phase 2: students will then be challenged with a longer distance.

Hints: Each student must be touching the track

Rules: No student may touch the marble, the marble cannot stop or fall off the track.

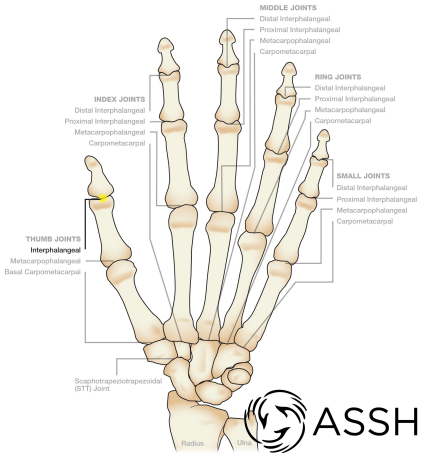
*If any of the rules are broken then the team much completely start over.

- ❑ Most common solution: The students will hold the foam tracks side by side and once the marble moves from there track to the person in front of them then they will move from the back of the line to the front. This will continue until the marble reaches the tub.

3) You will support students in making sense of the concepts through forming **EXPLANATIONS (KAT)**

1. There will be two parts to this lesson section and each will focus on the NOS tenant observation/inference. To get them thinking about the concepts in the activities, the instructor will ask:
    a. What helps to make parts of your body move like your fingers and toes? Is this a voluntary or involuntary muscle movement?
    b. Emphasize that muscles changing length makes these body movements occur.
2. We will begin with the chicken wing activity. Chicken wings will be prepared beforehand and passed out in plastic bags to each pair of students at a table. Each student will also get gloves.
    a. The instructor should start by asking the students at their table what they think would happen if they pulled on a certain part of the wing (the tendon). This will be their 'prediction' and they should write or draw it on a piece of paper.
    b. Then the instructor will ask the students to pull on the tendon and students should write or draw their observation. Did their prediction match their observation?
3. Next, we will do the paper hand activity! Each student will be given a piece of colored construction paper, a pencil and some scissors. The students will trace the outline of their hand onto the piece of paper and cut out a representation of their hand.
4. Next, students will tape on the provided pre-cut straw pieces to give structure to the hand (skeleton) and represent the places where the fingers bend (joints).
    a. Four of the straws will be cut into **4 pieces** for the fingers -- 3 small pieces (finger bones), 1 long piece that gives structure to the hand.
    b. One of the straws will be cut into **3 pieces** for the thumb -- 2 small pieces (finger bones), 1 long piece to give structure to the hand.
    c. Instructors can walk around and help with this. The picture of the skeletal hand below will be projected on the board to guide the taping process.
5. Lastly, students will be given five pieces of string/thread and tape the ends of each piece to the back side of the hand (the side without the straws). Then the string will be threaded through the straw pieces for each finger with loose ends coming out at the base of the hand.
6. After everyone has assembled their hands, the instructor should ask the class to think back to the chicken wing activity and what helped the chicken wing to move.
    a. Why do you think we showed you the chicken wing before we did the paper hand activity?
    b. Are there similarities between how you are making your hand move and how the educator made the chicken wing move?
    c. What is the string on the hand model supposed to represent?
    d. From your observations of both the chicken wing movement and the paper hand movement, does the paper hand move like your real hand?
        i. The hand has more muscles to support a broader range of movement -- the paper hand only has tendons!

e. Why might scientists be interested in studying how a human hand is able to move?
    i. Robotic and prosthetic hands!



4) Students will have an opportunity to **ELABORATE** on what they've learned this week and **Evaluate** the students through this assessment

Point system

Figure Skate: Team with the shortest time to complete the activity gets 5 points

Skiing Race: Team with the shortest time to complete the activity gets 5 points

Long Jump: Team with the longest jump gets 5 points

Mogul Race: Team with the shortest time to complete the activity gets 5 points

Mogul Race w/peanuts: Team with the shortest time to complete the activity gets 5 points

Javelin: Team with the longest throw gets 5 points

OBSTACLE COURSE:

Each team will try to get through each obstacle as quickly as they can. Each adult will keep track of the time it took each team to complete the obstacle they are overseeing. Teams will recieve points based on which teams complete them the fastest.

Sock speed skate:

This will take place in the center of the atrium. I will use masking tape to tape an oval track. I will mark a Start/Finish line with masking tape also.

Students will be wearing socks and will "skate" in their socks around the oval taped out in the atrium. They will "skate" around the oval two at a time. Whomever completes two laps wins. I will also be recording the time for each team.

Moguls Race:

This will take place in front of the auditorium room in the atrium. I will mark off the "course" with two lines of masking tape. There will be an X on the course marked with masking tape every couple feet. The students will tape on the styrofoam skies with masking tape and hold a meter stick in each hand. They will have to "ski" around the X's to get to the finish line. When they reach the end, they will tag a partner and give them the skis and meter sticks and the partner will "ski" back across the course. The team to do this in the least amount of time wins.

Moguls Race w/Peanuts:

This will take place right beside the Moguls race and will be the same except for this time, the student will have to put their hands in grocery bags that will be filled with packing peanuts and tied around their arms. This will restrict muscle movement and simulate trying to ski with a large coat on. Again, whichever team completes the obstacle in the least amount of time wins.

Long Jump (Kat)

This will take place in the hallway that is stemming west from the atrium. I will use masking tape to make ten 1 foot apart marks on the ground and label them 1-10 with a sharpie. I will also mark a starting line one foot from the first piece of tape. As Ashley points out below, this activity will be done by all six teams as they move through rotation. Each student will stand on the starting mark and jump as far as they can when I say jump. The farthest jumping length will be recorded for each team. After all of the teams have rotated through, the team with the farthest jump will receive the highest score for the activity (these will count as the Olympic points for the activity).

Questions for during the activity:

- What kinds of muscles are you using for the long jump? (Glutes, quadriceps -- leg muscles, core strength, arm muscles for balance)
- Would you use different muscles if you got a running start?
- What are some exercises that you can think of that might help you build the muscles used in the long jump?

Javelin (Ashley)

This will be in the hallway going south from the atrium. I will mark off ten 1 foot measurements using tape (and have an extra meter stick to collect more precise measurements). This will work in rotations where each group (1-6) will rotate from activity to activity. Here, one at a time, they will throw a pool noodle and it will be a competition of who can throw it the farthest distance (they each get three tries, the best is collected). Overall this will be a competition for the Olympic points. (6 for the "highest" score, 1 for the "lowest" score).

Questions:

- When you are throwing the pool noodle, what muscles are you using (arm muscles, triceps, biceps, deltoid, forearm, hand)
- Are you using any other muscles? What about your core or legs?
- How is this activity correlated to the chicken wing we showed you earlier?
- What kind of movements are your different muscles doing?
    - Isometric - length of the muscle does not change, but the amount of tension increases with contraction that is opposing the load.
    - Concentric - the muscle length shortens during contraction, overcomes opposing resistance of the load.
    - Eccentric - the muscle length lengthens due to tensions created by the load.

5) **EVALUATE** What will you do to learn if your students met the objectives for this week?

Overall, formative evaluations will be spread throughout the lesson sections when leads ask students to clarify/explain their understanding. We will be asking questions to guide their thinking throughout the lesson, and will measure their understanding through engagement in class discussions and from answering questions about which muscles are at work during different Olympic sports.

I) PEDAGOGICAL FOCUS: Nature of Science

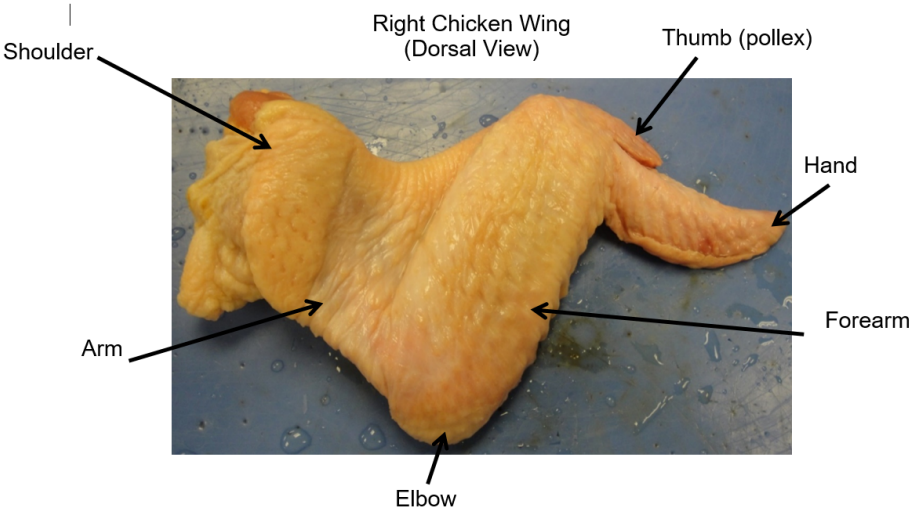
Nature of Science:

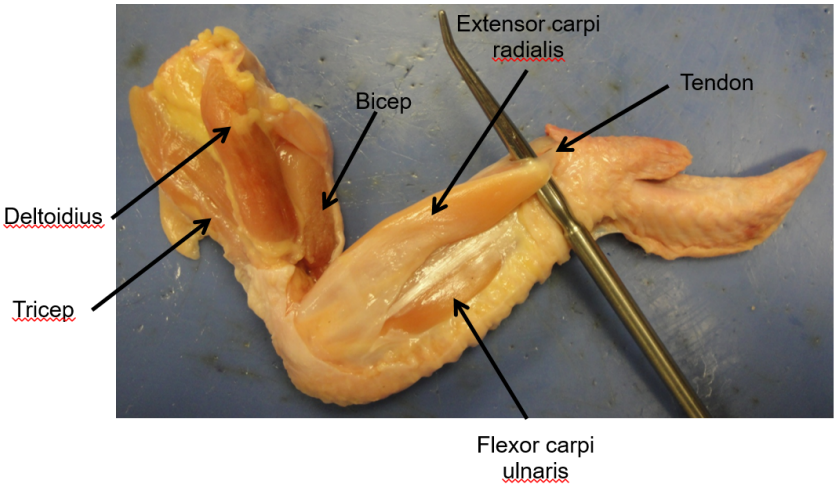
- We will be emphasizing the difference between **qualitative** and **quantitative** data (I feel this muscle working when I jump is qualitative, I can squeeze a ball for 60 seconds before my hand is tired is quantitative)

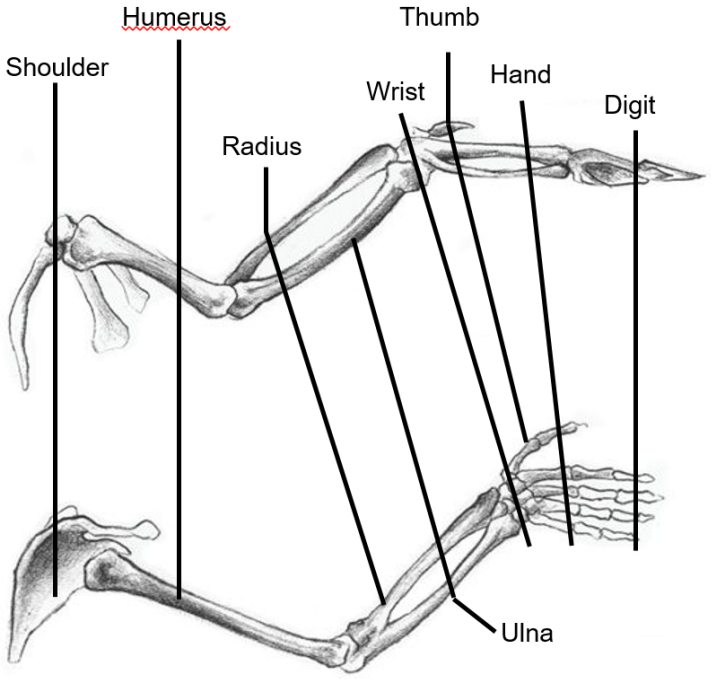
- We will also ask the students to **infer** which muscles they are using during different types of physical activity from the **empirical evidence** that they felt a pressure or force in that muscle
- During the explain phase, we will be emphasizing **observations and inferences** by having students use their observations of the chicken wing to make inferences about what's going on with the paper hand AND why the paper hand doesn't have as much range of motion as the chicken wing.

Olympic Summer Obstacle activities

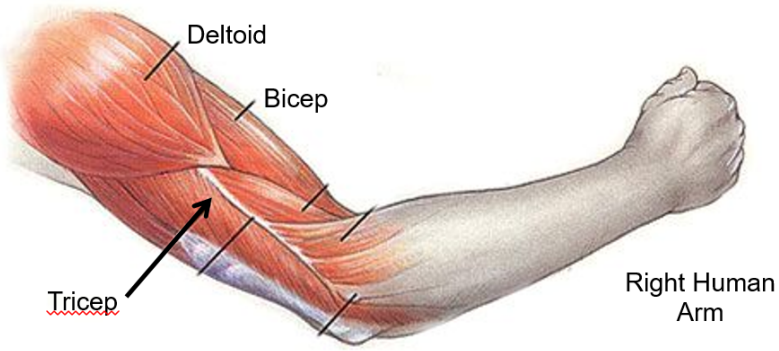

10 9 8 7 6 5 4 3 2 1
JUMP


Right Chicken Wing
(Dorsal View)
Shoulder
Thumb (pollex)
Hand
Arm
Forearm
Elbow


Extensor carpi
radialis
Bicep
Tendon
Deltoidius
Tricep
Flexor carpi
ulnaris



Comparison of Right Chicken Wing and Human Arm



Muscle Physiology Activities

Purpose: Explore the muscles' response to intermittent contractions and sustained contractions.

Materials: squeeze ball (or tennis ball) and a watch with second hand.

Activities:

Sitting quietly, grasp squeeze ball. At the start signal, squeeze and release, once per second until you are unable to continue. Time how long this takes. Write the amount of time here.	
Rest one minute and repeat with the other hand. Write the amount of time here.	
Return ball to the original hand. At the start signal, squeeze the ball and hold the squeeze continuously until you are unable to continue. Time how long this takes. Write the amount of time here.	
Rest one minute and repeat with the other hand. Write the amount of time here.	

Outcome: You should notice discomfort and fatigue as you perform the intermittent contractions (the first experiment); this should occur faster in your non-dominant hand. You should find that fatigue occurs faster during the sustained contraction. You may not find a difference between your dominant hand and non-dominant hand.

Background and Significance: Discomfort and progressive loss of strength occur with repeated contractions due to muscle fatigue. The effect is greater during sustained contractions as blood flow is impeded because of muscles compressing blood vessels. Rhythmic contractions actually promote blood flow by alternately compressing and relaxing against the vessels (see the cardiovascular activities on the previous page). With leg exercises (such as knee bends), larger muscles are involved, which stimulates the cardiovascular system, respiratory system, and cooling system. Fatigue can 'protect' a muscle from injury.

Questions for Group Discussion:

- Why do muscles fatigue?
- Why does it hurt when your muscles get tired?
- Why can you do more exercise when it is performed rhythmically compared to continuously?
- Why does leg exercise stimulate more systems than arm exercise?

* Activity presented by Steven S. Segal, Ph.D., Yale University School of Medicine, at the Experimental Biology '99 workshop for teachers and students, Washington, DC.

Q405/E548 Saturday Science Teaching – Spring 2018

LESSON #4 STEM Integration

4th and 5th Grade

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

Learning Objectives:

1. The students will investigate how body position affects performance during Olympic activities, such as curling or skiing.
2. The students will test different materials and designs and apply this to creating skis and curling stones, then describe their findings and discuss what changes they would make to their original design (practice engineering).

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

- What science and engineering practices are you addressing in this lesson:

3. Planning and carrying out investigations

4. Analyzing and interpreting data

6. Constructing explanations

7. Engaging in argument from evidence

- What cross cutting concepts are you addressing in this lesson:

2. *Cause and effect:* Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

4. *Systems and system models*. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for

understanding and testing ideas that are applicable throughout science and engineering

6. *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. 7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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

We need to know that there are different ways to create stable skis and curling stones, and that the materials and the designs both matter. There are multiple ways to make effective tools.

We need to know that more range in motion leads to bigger movements

We also need to know the rules of the game of curling (http://www.nbcolympics.com/news/curling-101-rules)

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

Assuming 24 students - 6 groups of 4 students

Establishing Rules for the Classroom

- ❑ 3 rolls of masking tape
- ❑ A big sheet of paper (like a big sticky note if possible, to hang a list of student-created "Class Contract")- Have the students sign the contract
- ❑ 2 Sharpie Markers

Skis **(THEY WILL BE KEEPING THESE)**

- ❑ Styrofoam pieces (no set amount, will be used when designing own skis - maybe multiple sheets that aren't huge)
- ❑ About 50 sheets of paper
- ❑ About 50 sheets of cardstock or construction paper
- ❑ 3 rolls of duct tape
- ❑ 48 pieces of cardboard, slightly bigger than a shoe (will be used as a ski)
- ❑

Curling **(TAKING THIS HOME WITHOUT THE ROCKS/SAND)**

- ❑ 30 clear plastic "jam" containers with lids
- ❑ Large Rocks/Small Rocks/Sand (enough to fill each jug halfway)
- ❑ Long measuring tape (1)

- ❑ 50 pipe cleaners
- ❑ 12+ scissors
- ❑ 24 paper towel/toilet paper rolls
- ❑ 24 egg cartons
- ❑ 1 extra long measuring tape on reel
- ❑ 3-4 Clipboards

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

- ❑ http://www.nbcolympics.com/news/curling-101-rules
- ❑ https://www.youtube.com/watch?v=WFcuL6CKeAU
- ❑ https://www.youtube.com/watch?v=59SWAVPH4Xc

F) TENTATIVE TIMELINE (Keep brief)

8:30 am - 9:30 am: Set up

9:30 am - 9:40 am: Create Classroom Expectations

9:40 am - 9:50 am: Video/Intro to the day/Propose focus question

9:50 am - 10:05 am: Create skis

10:05 am - 10:15 Test skis **(Will go to atrium)**

10:15 am - 10:30 am: Discuss what worked and what didn't and modify skis

10:30 am - 10:40 am: Re-test skis **(Will go to atrium)**

10:40 am - 10:55 am: Snack

10:55 am - 11:05 am: Curling video

11:05 am - 11:30 am: Make curling stones

11:30 am - 11:45m: Curling **(Will go to atrium)**

11:45 am - 12:00 pm: Wrap Up

G) DESCRIPTION OF YOUR LESSON: Learning Cycle (Engage, Explore, Explanations, Elaborate)

3) **ENGAGE (Crystal & Kelsey)**
BEFORE the day starts we will make classroom expectations on a big piece of paper, it will be created by the students, thus holding them accountable. Create a class contract and have each student sign it. Make sure they know after 2 warnings they will be sent to Kerri to sit out of the activity.

a) **Focus Question:** How does range of motion affect the performance of the Olympian?

i) Teacher will propose the focus question and ask students to think about the focus question throughout the days' activities.

Comment [1]: Hi! Unless Meredith suggested 1, I would give them 2 warnings unless the behavior is particularly disruptive and they need me so speak to them privately. I'll be sorting the T-shirts by the carrels that morning so you can find me easily :) I like the expectations-ask them to contribute to the expectations. What do they think good classroom behavior is?

Video: https://www.youtube.com/watch?v=WFcuL6CKeAU

This video is about an Olympic skier talking about how he makes his skis and is developing a strong, yet bouncy ski that will help him in his freestyle skiing competitions.

Questions:

- What motions were the skiers doing? Specifically their legs. This has an effect on speed and balance.
- What do you want in a good ski? It needs to be firm enough to support you, but bouncy to give you good jumps. Also some friction, but also slick enough that you don't stop.
- What materials or designs do you think a good ski could be made out of? Brainstorm!
- Create a blueprint for your skis.

STEAM Integration: Science, Engineering, Technology

Science: The different range of motion has varying effects on speed and balance while skating

Technology: Creating the blueprint

Engineering: The kids will be able to engineer the best ski they can make with the supplies given

Art: They can create their own designs

2) The students will **EXPLORE** the concept through gathering data/investigating/experimenting etc **(Ashley)**

We will then give the kids various supplies (styrofoam, paper, cardstock, duct tape, etc.) and ask them to construct their own skis on the supplied cardboard cutouts.

After their skis are created we will watch a video on skier stance:

https://www.youtube.com/watch?v=9EC7pt1G2ZU

Then, have them test them varying three different leg movements (shuffle, walk, long strides) on the same surface to control for friction. To help them with figuring out the movements, we will draw a simple picture to outline the different ranges of motion.

In the atrium, we will tape a start and finish line. We will have all of the students go at once and take the time for the first and last student to cross the finish line (and average these numbers) as a general time for the whole class. We will do this three times -- once for each range of motion. We will have a brief discussion about which range of motion gave the fastest time. The focus is the BODY.

Design Number	Position 1	Position 2	Position 3
1			

STEAM Integration: Science, Technology, Engineering, Art

Science: The different range of motion has varying effects on speed and balance while skating

Technology: Creating the blueprint

Engineering: The kids will be able to engineer the best ski they can make with the supplies given

Art: They can create their own designs

3) You will support students in making sense of the concepts through forming

EXPLANATIONS (Crystal)

The students will be asked to engage in a discussion about which stance allowed them to skate the course the fastest and why that was. Let them know that we are all different in muscle mass, height, and limb length. This is will affect the range of motion and potentially how fast or slow you are able to move.

After we talk out the ideas above, we will ask the students how they might modify their ski designs to better support a larger range of motion/faster speed. We could write some of their brainstorming on the board. After everyone seems to have some good ideas, they will be asked to

go back to the worksheet where they originally drew their design and draw or explain what they would change on their design and why.

Next, the students will spend some time modifying and testing their ski designs in the atrium. Like before, we will take the times for each movement (3 times), but this time we will let the students choose which stance they want to try with the modified skis. We will have them go in groups according to stance/position preference.

Design Number	Position 1 Time	Position 2 Time	Position 3 Time
2			

To conclude this ski building activity, we will have a whole class discussion about how their changes affected ski time. How did their modifications work with the different stances? How did your ski design compare to others? What materials were most effective to facilitate a large range of motion? Why?

STEM Integration

Science: The different range of motion has varying effects on speed and balance while skating

Technology: Creating the blueprint

Engineering: The kids will be able to engineer the best ski they can make with the supplies given, the EDITING process is important here!

Art: They can create their own designs

4) Students will have an opportunity to **ELABORATE** on what they've learned this week and **Evaluate** the students through this assessment **(Kelsey)**

Students will watch a video on what curling is and how to play. We will make sure that every student knows they will be pushing the "curling rock" the same way (full range of motion).

https://www.youtube.com/watch?v=59SWAVPH4Xc

Then, each student will get a small plastic container. Each student will get a worksheet and produce an initial design an ergonomically efficient handle for the curling stone. They will have access to different types of materials to create the handle (paper towel roll, pipe cleaners, etc.). Each **group** will be given a *design constraint* (engineering design principle) in the form of what kind of material will act as a weight for the curling stone (small rocks, large rocks, sand). So, for

6 groups, 2 groups will get small rocks, 2 groups will have big rocks, and 2 groups will have sand. We will have the containers pre-filled with the weights and taped for safety. Groups will be asked to keep the weight material in mind when designing the handle.

After they have created their curling rocks, each group will test pushing their curling rock on tile in the atrium and we will measure the distance each curling stone goes using a meter stick/measuring tape and pre-taped distances.

Group	Distance Player 1	Distance Player 2	Distance Player 3	Distance Player 4
Sand 1				
Sand 2				
Sand 3				
Small Stone 1				
Small Stone 2				
Small Stone 3				

STEAM Integration:

Science: The different range of motion has varying effects

Technology: Creating the blueprint

Engineering: The kids will be able to engineer the best curling stone they can make with the supplies given

Art: They can create their own designs

5) **EVALUATE** What will you do to learn if your students met the objectives for this week? **(Kat)**

After we have tested the curling stones, we will return to the classroom and discuss the different curling stone ideas that allowed the curling rock to travel the farthest distance.

- What kinds of materials worked best for the handle? What design worked best for the handle?
- How did the weight material have an effect on your choice of material/handle design?

- If you could change one thing to improve your design for next time, what would it be? What if you were assigned a different weight?

We will ask students how this activity related to the ski activity and we will ask them how the different body positions or materials related to how fast the students could complete the activity. Finally, we will discuss the focus question and come up with a concise answer.

I) PEDAGOGICAL FOCUS:

STEM integration:

- Science: The different range of motion has varying effects on speed and balance while skating, and has an effect in curling
- Technology: Creating the blueprint
- Engineering: The kids will be able to engineer the best ski/curling stone they can make with the supplies given
- Art: They can create their own design

Skiing

[Trial #1] Draw a blueprint of what your ski looks like:

Results/Test:

Describe or show what happened when you tested your ski, and how was it affected by your

stance and materials?

What worked?:

What didn't work?:

Now, how would you like to change your design? Why?

[Trial #2] Changes to your Original Blueprint:

Results/Test:

Describe or show what happened when you changed your ski, and how was it affected by your stance and materials?

What worked?:

What didn't work?:

Curling

[Trial #1] Draw a blueprint of what your curling rock looks like:

List materials for Handle:

Rock Material:

Results/Test:

Describe or show what happened when you tested your curling rock, and how was it affected by your materials?

What worked?:

What didn't work?:

Now, how would you like to change your design? Why?

[Trial #2] Changes to your Original Blueprint:

Results/Test:

Describe or show what happened when you changed your ski, and how was it affected by your materials?

What worked?:

What didn't work?

Curling Table for the Adults

Group	Distance Player 1	Distance Player 2	Distance Player 3	Distance Player 4
Sand 1				
Sand 2				
Small Stone 1				
Small Stone 2				
Large Stone 1				
Large Stone 2				

`Q405/E548 Saturday Science Teaching – Spring 2018

LESSON #5 Reflexes, Control of Movement, Nervous System

4th and 5th Grade

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

Learning Objectives: Putting it all together, how are Olympians able to compete?

Understand and be able to describe the following concepts of the Nervous System:

1) Increased Respiration (breathing) - during physical activity.
2) Increased Heart Rate - during physical activity.
3) Voluntary/conscious control of body movements - stimuli are transmitted via nerves to the target skeletal muscle.
4) Reaction time - time in milliseconds (ms) it takes for the brain to interpret a sensory signal (sight) and cause an action (closing fingers).

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

What science and engineering practices are you addressing in this lesson:

3. Planning and carrying out investigations

4. Analyzing and interpreting data

6. Constructing explanations

7. Engaging in argument from evidence

- What cross cutting concepts are you addressing in this lesson:

2. *Cause and effect:* Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

4. *Systems and system models*. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering

6. *Structure and function*. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions. 7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

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

- When there is more distraction, or an outside stimulus, reaction time can be affected (usually making it longer)
- Reaction times can be shortened through practice
- Reaction pathway: stimulus, sensory neuron, spinal cord/brain, motor neuron, response
- Our nervous system affects/connects our 5 senses
- The nervous system controls our body (we have already talked about respiratory system, circulatory system, muscles, and range of motion)
- When we do physical activity, our breathing increases and heart beats faster
- Our muscles help us move, and range of motion is important for different activities

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

Assuming 24 students - 6 groups of 4 students

- ❑ Class rules (from last time, was with the cardboard skis)

Reaction time

- ❑ 12 ideally, at least 6 Meter sticks (rulers can work too if there aren't enough meter sticks)
- ❑ Cotton Balls (25)
- ❑ 24 pairs of goggles/safety glasses (just a clear cover for their eyes)

Obstacle Course

- ❑ Masking Tape (5 rolls)
- ❑ Pool Noodles (2)
- ❑ Plastic Grocery Bags (20)
- ❑ Peanut styrofoam (enough to fill 20 grocery bags)
- ❑ 6 meter sticks
- ❑ Cones or paper cups (8)

- ❑ Skis from last week

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

Reflex Test: https://faculty.washington.edu/chudler/chreflex.html

6 Exercises to Improve Agility: https://www.acefitness.org/education-and-resources/professional/expert-articles/3782/6-exercises-to-improve-agility

https://www.scienceworld.ca/resources/activities/reaction-time-ruler

https://learning-center.homesciencetools.com/article/measure-reaction-time-science-project/

http://www.radford.edu/jkell/Reaction%20Times.pdf

F) TENTATIVE TIMELINE (Keep brief)

8:30 am - 9:30 am: Set up

9:30 am - 9:40 am: Introduction to the day, video

9:40 am - 10:10 am: Engage: Cotton Ball activity

10:10 am - 10:40 am: Explore - Reaction time with meter sticks

10:40 am - 10:55 am: Explain - Questions, going over nervous system

10:50 am - 11:05 am: Snack

11:00 am - 11:40 am: Extend - Obstacles

11:40 am - 11:50 am: Wrap - Up, review questions

11:50 am - 12:00 pm: Medal Ceremony

G) DESCRIPTION OF YOUR LESSON: Learning Cycle (Engage, Explore, Explanations, Elaborate)

4) **ENGAGE** (Kelsey)

We will begin class by asking the students: What is a reflex?

A class discussion will follow with a teacher writing student answers on the board.

Blink reflex

Students will work in pairs.

5) One student will wear safety goggles while the other student throws a packing peanut at their face, causing them to have a reflex of blinking.
6) Then students will switch roles and do the activity again.
    a) **Focus Question:** How are the body systems of an athlete integrated and controlled during Olympic events?

        i) Teacher will propose the focus question and ask students to think about the focus question throughout the days' activities.

2) The students will **EXPLORE** the concept through gathering data/investigating/experimenting etc (Crystal)

The students will make hypotheses about reaction times (dropping and re-catching a ruler) and how it can be affected by different stimuli. All data will be averaged by table then put into the following chart (which will be in an Excel file, making it easier to convert to a graph).

The first time they will do this, they will measure "simple reaction time," by just dropping/re-catching the ruler without a cue (distance will be measured and put into an excel sheet, referring to chart in Handouts section). The ruler will be help at one end (0 cm/inches) and the hand will not move, just fingers. To make sure the hand doesn't move, it will rest on the table and just the hand will hang off. This is the same for all of the trials.

The second time, a word (spoken by the lead teacher, that is not counted down by a 3, 2, 1…, and that is said in combination with other non-cuing words) will be the cue of when to drop/re-catch. Data will be taken again. Failure to drop with the word will also be counted.

The third time, another student will hold the meter stick then randomly drop it. (Still 0 is at the bottom)

Then, the data will be turned into a bar graph using averages for each reaction. The students will then analyze the data and offer insight to why the bar graph increases through the different tests.

Team	Control (s)	"Code Word" (s)	Another Student (s)
1			
2			

3			
4			
5			
6			
Average			

3) You will support students in making sense of the concepts through forming **EXPLANATIONS** (Ashley)

Questions about the experiment performed in Explore:

- What did we observe?
    - There is more of a distraction/delay when you're listening to/for different words (stimulus), and especially when you have to respond
- Does this relate to our previous hypothesis?
- Why do you think we observed this?
    - Multitasking/Responding to multiple stimuli slows reaction time overall, when compared to just doing one activity
- Do you think reaction time is important in sports? Which ones? Why?
- How do you think Olympians train for the best reaction times?
    - Practice!

How do your senses work? How do you react to a stimulus?

- There is a chain of command through the *nervous system*
- stimulus, sensory neuron, spinal cord/brain, motor neuron, response (draw arrows on handout)
- This is true for our five senses: touch, taste, smell, sight, hearing

Now, notice your reactions when we do the next activities. Notice all of the things we have talked about before

- Respiratory System
    - After physical activity, what does your body do? (breathe heavier/more often to distribute oxygen)
- Circulatory System
    - After physical activity, what does your body do? (heart beats faster to distribute oxygen)
- Muscles

    - How can you do your muscles help you move? (extend/contract)
    - After physical activity, what does your body do? (muscle fatigue)
- Range of Motion
    - Skiing activity: Different ranges of motion allow different activities to be performed (faster and slower)

4) Students will have an opportunity to **ELABORATE** on what they've learned this week and **Evaluate** the students through this assessment (Kat)

Point System

Skiing Race: Team with the shortest time to complete the activity gets 35 points (decrease by 5 point increments so last place gets 10 points)

Long Jump: Team with the longest jump gets 35 points

Mogul Race: Team with the shortest time to complete the activity gets 35 points

Mogul Race w/peanuts: Team with the shortest time to complete the activity gets 35 points

Javelin: Team with the longest throw gets 35 points

OBSTACLE COURSE:

Each team will try to get through each obstacle as quickly as they can. Each adult will keep track of the time it took each team to complete the obstacle they are overseeing. Teams will recieve points based on which teams complete them the fastest.

Sock speed skate:

This will take place in the center of the atrium. I will use masking tape to tape an oval track. I will mark a Start/Finish line with masking tape also.

Students will be wearing socks and will "skate" in their socks around the oval taped out in the atrium. They will "skate" around the oval two at a time. Whomever completes two laps wins. I will also be recording the time for each team.

Moguls Race:

This will take place in front of the auditorium room in the atrium. I will mark off the "course" with two lines of masking tape. There will be an X on the course marked with masking tape every couple feet. The students will tape on the styrofoam skies with masking tape and hold a meter stick in each hand. They will have to "ski" around the X's to get to the finish line. When they reach the end, they will tag a partner and give them the skis and meter sticks and the partner will "ski" back across the course. The team to do this in the least amount of time wins.

Moguls Race w/Peanuts:

This will take place right beside the Moguls race and will be the same except for this time, the student will have to put their hands in grocery bags that will be filled with packing peanuts and tied around their arms. This will restrict muscle movement and simulate trying to ski with a large coat on. Again, whichever team completes the obstacle in the least amount of time wins.

Long Jump (Kat)

This will take place in the hallway that is stemming west from the atrium. I will use masking tape to make ten 1 foot apart marks on the ground and label them 1-10 with a sharpie. I will also mark a starting line one foot from the first piece of tape. As Ashley points out below, this activity will be done by all six teams as they move through rotation. Each student will stand on the starting mark and jump as far as they can when I say jump. The farthest jumping length will be recorded for each team. After all of the teams have rotated through, the team with the farthest jump will receive the highest score for the activity (these will count as the Olympic points for the activity).

Questions for during the activity:

- What kinds of muscles are you using for the long jump? (Glutes, quadriceps -- leg muscles, core strength, arm muscles for balance)
- Would you use different muscles if you got a running start?
- What are some exercises that you can think of that might help you build the muscles used in the long jump?
- How does your body know what to do? What system is "telling" it what to do? (stimulus, sensory neuron, spinal cord/brain, motor neuron, response)

Javelin (Ashley)

This will be in the hallway going south from the atrium. I will mark off ten 1 foot measurements using tape (and have an extra meter stick to collect more precise measurements). This will work in rotations where each group (1-6) will rotate from activity to activity. Here, one at a time, they will throw a pool noodle and it will be a competition of who can throw it the farthest distance (they each get three tries, the best is collected). Overall this will be a competition for the Olympic points. (6 for the "highest" score, 1 for the "lowest" score).

Questions:

- When you are throwing the pool noodle, what muscles are you using (arm muscles, triceps, biceps, deltoid, forearm, hand)
- Are you using any other muscles? What about your core or legs?

- What kind of movements are your different muscles doing?
    - Isometric - length of the muscle does not change, but the amount of tension increases with contraction that is opposing the load.
    - Concentric - the muscle length shortens during contraction, overcomes opposing resistance of the load.
    - Eccentric - the muscle length lengthens due to tensions created by the load.
- How is your breathing? Heart rate?
- How does your body know what to do? (stimulus, sensory neuron, spinal cord/brain, motor neuron, response)

5) **EVALUATE** What will you do to learn if your students met the objectives for this week?

Overall, formative evaluations will be spread throughout the lesson sections when leads ask students to clarify/explain their understanding.

We will also bring the kids up to the classroom and go over what they learned at the different stations through a class discussion before the medal ceremony.

What did you learn throughout your five weeks here?

- Respiratory System
    - After physical activity, what did your body do? (breathe more often to distribute oxygen)
- Circulatory System
    - After physical activity, what did your body do? (heart beats faster to distribute oxygen)
- Muscles
    - How did your muscles help you move? (extend/contract)
    - After physical activity, what did your body do? (muscle fatigue)
- Range of Motion
    - Describe what you did in the different activities
- Nervous System
    - How did you know what to do? (stimulus, sensory neuron, spinal cord/brain, motor neuron, response)

I) PEDAGOGICAL FOCUS: Science for all

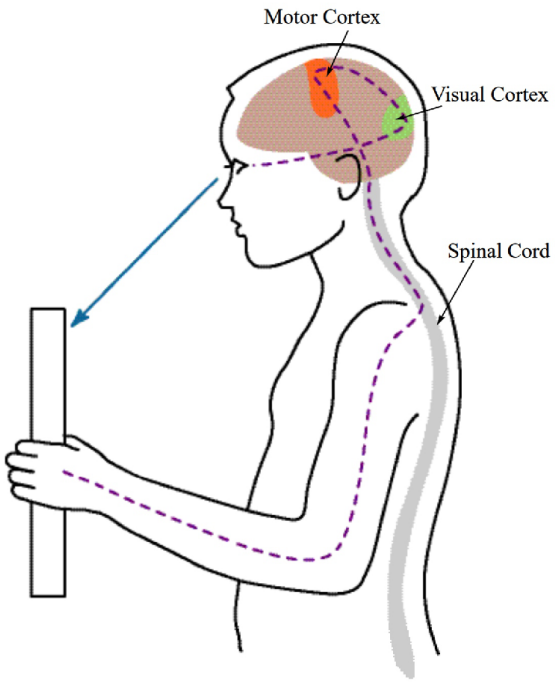
ELL integration: Assessing for Learning

-We will have many discussions throughout the lesson where kids can demonstrate their understanding of this week's material. During the obstacle course activity, students will move around in groups of four and instructors could have smaller discussions with them about the nervous system, muscle movement, etc.

-During the explain activity, we will have students draw out a sensory response path on a worksheet that we provide with a word bank. This is to get them thinking about/demonstrate understanding about what their body will be doing during the ruler drop exercise.

Handouts

Reaction Time Poster



Reaction Time Table **(Conversion Table (modified from Neuroscience for Kids)**

Distance (from 0 on meter stick)	Time
2 in (~5 cm)	0.10 sec (100 ms)
4 in (~10 cm)	0.14 sec (140 ms)
6 in (~15 cm)	0.17 sec (170 ms)
8 in (~20 cm)	0.20 sec (200 ms)
10 in (~25.5 cm)	0.23 sec (230 ms)
12 in (~30.5 cm)	0.25 sec (250 ms)
17 in (~43 cm)	0.30 sec (300 ms)
24 in (~61 cm)	0.35 sec (350 ms)
31 in (~79 cm)	0.40 sec (400 ms)
39 in (~99 cm)	0.45 sec (450 ms)
48 in (~123 cm)	0.50 sec (500 ms)
69 in (~175 cm)	0.60 sec (600 ms)