Bay Area Scientists in Schools Presentation Plan

Lesson Name: Bones, Muscles, and How we Move
Presenter(s): Matt Rubashkin & Alec Cerchiari

Grade Level: 5th
Standards Connection(s): Multicellular organisms have specialized structures

Next Generation Science Standards:

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. - Develop a model to describe phenomena. (4-PS4-2) - Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)	LS1.A: Structure and Function - Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)	Cause and Effect - Cause and effect relationships are routinely identified. (4-PS4-2) Systems and System Models - A system can be described in terms of its components and their interactions. (4-LS1-1), (LS1-2)

Common Core Standards:

ELA/Literacy:

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.

FOSS Connections:

Grade 5 Module: Living Systems

Investigation 1: Living Cells

Teaser: Today I will be talking about our bones, muscles and how we move; and then you will all be engineering a new species, an alien if you will, with its own skeletal and muscular systems.

Objective: *As a result of your lesson, what will students learn? What will they be able to do?*

- Skeletal system: Why we have bones (what would happen if we did not have a skeletal system), what bones are made out of (minerals and calcium!), why human are vertebrates, and examples of invertebrates,
- Muscular System: How is it possible for us to move our skeleton, how does the human muscular system aid in movement, why is it important to exercise regularly

Vocabulary / Definitions: *3 – 6 important (new) words*

- Calcium: Is a chemical element and mineral found in the body. Calcium is essential for living organisms
- Collagen: Is a protein found in living organisms. It is found in tissues such as bone, muscle, and tendon. It makes up 25% of all the proteins in our bodies!
- Connective Tissue: Is any tissue which holds the body together. These tissues such as bone and muscle enable us to stand up and move around.
- Vertebrate: Are species with backbones, known as vertebrae, and a spinal cord which contains nerves.
- Invertebrate: Are species without a backbone. Examples include bugs such as flys, and corral.

Materials:

What will you bring with you?

- Stand-Alone Plastic Mold Skeleton
- Supplies to create alien model
  - ☐ Copper wire (precut to 2 foot segments - 8 per group)
  - ☐ Metal Washers: Small and Large (4 total)
  - ☐ Cardboard Washers: Small and Large (4 total)
  - ☐ Rubber Bands (6 per groups)
  - ☐ Red String (5 feet per group)
  - ☐ My alien model: 4 armed and one legged alien

What should students have ready:

- Pencils
- Paper
- scissors

Classroom Set-up:

- Students should be in groups of 4 to 5
- I will need around 15 minutes to set up, and class can participate in a 5 minute clean up

Classroom Visit

1.Personal Introduction: _____5____ Minutes

Hi my name is Matt Rubashkin and I am a scientist and student at the University of California

Before I start today, I want to tell you about why I got interested in bones, muscles and science. I'll tell you a secret too, it started with my skateboard... and ended in the doctor's office. I have successfully broken my clavicle twice (point to collar bone on the skeleton), ulna bone (point to elbow and wrist), lots of fingers and toes, but most fortunately for me, I've destroyed two helmets, so my head is still good to go!

Who here has broken any bones? (Ask students to point at the skeleton to identify the bones)

Briefly give a background on what I perform my research on:

- I am an engineer and biologist
- I investigate how bones form as a baby and as you grow into an adult
- With this knowledge i create new materials to help fix bones and muscles after injury, such as a sports injury, like football (or another example of how someone broke their bone)

Topic Introduction: **____10_____ Minutes**

Questions for the class:

- Are human classified as vertebrates? Lets have a vote (yes, no, neither)
  - I then explain why humans are classified this way
  - Start the vocab section on the far right side of board, write vertebrate
- Does anyone know of some animals that are invertebrates?
- If we had flexible bones, what would happen? Ask class.
  - Hopefully someone answers, if not explain that we would be like jellyfish, and not be able to resist gravity!
- What our are bones made of? Give groups 1 minute to brainstorm ideas. Write on the board the following options (under the word bone) as people mention:
  - Blood
  - Cells
  - Calcium
- Explain what it is: an element that forms the strong minerals
- Explain that we get calcium from our diet. Milk, but also dark leafy greens: collard greens, kale, bok choy, spinach.
  - Collagen- a large protein that binds the calcium/minerals into a strong matrix
- We are able to move our arms, legs, hips and ankles through muscles. Make it clear that the red string will represent the muscle.
  - Have red string on the skeleton connected from acromion of shoulder to lateral humerus, show how an arm is raised
  - Have red string on the skeleton connected from anterior-superior humerus to proximal-anterior radius, show bicep flex. Ask the students here to feel their own bicep so that they can feel the tension in the muscle and the bone.
  - Explain that the shoulder and elbow are joints (write the word joint on the board), which form the junction of bones, and allow bones to slide over one another

- Ask the kids: "If I want the skeleton to kick up it's leg, where should the muscle go? Where should I put the string?"
- ACTIVITY (if time permits): Ask for a student to come up and try attaching the string. Illustrate how tension in the muscles will move the static bone

2.Learning Experience(s): ___25_____ Minutes

What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

●Constructing an alien body

- Give students supplies
- Before they start explain:
  - Goal is to create an alien consisting of bones (wire), joints (washers – also double as heads) and muscles (string and rubberbands). Write these guidelines on the board
  - Pull out my personal alien, show for 30 seconds with brief explanation, then put away
- <u>WORKSHEET TIME</u> (5 mins):
  - Ask the students to fill out the attached worksheet (is two pages, one writing, one drawing)
    - ●How many limbs, heads
    - ●How many types of motion (walking, throwing spears, with one or two arms etc?)
    - ●How many joints
    - ●How many muscles will you need?
- Hand out supplies when worksheet finished.
- Give them 10-15 minutes to construct their alien with the following caveats (write these rules on the board as they are building their aliens):
  - Need to explain where the alien lives
  - What supports your alien's body, are these structures rigid or flexible?
  - How the alien moves around- does it have feet, and how many?
  - Is your alien a vertebrate or invertebrate
  - Groups should select a leader to explain their alien to the class
  - <u>FINISH WORKSHEET</u>:
    - ●How many muscles did you use?
    - ●How many joints did you use?
    - ●What type of motions are possible?
- Each group will then have 1 minute to demonstrate alien

3.Wrap-up: Sharing Experiences **___5_____ Minutes**

Explain that I really liked all of the aliens, and I think they will do well on their home planets As everyone saw the muscular system forces the skeleton to move, aiding in movement such as walking, talking, jumping and skateboarding.

4.Connections & Close: **____5_____ Minutes**

- Before I go and make you clean up your materials, I want to tell everybody of how they can apply this lesson to their future.
- Having a healthy diet consisting of milk and vegetables will help you have strong bones composed of calcium and collagen.
- Exercise is critical to keeping your muscles strong. Bones and muscles are considered connective tissue (write on board in the vocab section).

- Stretching is important to keep your connective tissues healthy, by increasing the flexibility and control over your muscles.
- Now everybody help me clean up this mess, I have boxes for extra supplies, and the teacher can keep your aliens for you to play with in the future.

Total 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to connect alien parts. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students create a second alien with a more complex structure.

Follow-up Possibilities

ELA Activity:

Suggest students write a letter explaining "How we learned about bones, muscles and how we move?" And will use my smart phone to take pictures of their aliens to include in their report.

Reading Connections:

- The Complete Human Body by Alice Roberts DK Publishing. 512pp. Trade ISBN 9780756667337, $50. (6–12) DVD enhanced, this ambitious volume examines human evolution, anatomy, function, reproduction, and disease in an orderly, up-to-the-minute visual format. Glossary, Index. (NHM) IV. Supplemental Material: Virtual labs on cardiology, neurology and other topics (The Howard Hughes Medical Institute) http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=20606

- Understanding Your Muscles and Bones: A Guide to What Keeps You Up and about (Usborne Science for Beginners) by Rebecca Treays - Uncovering the frame of the human body, this text takes a close look at the tissues that keep us up and about. It explains the structure of the skeleton and the mechanics of movement. It also examines the importance of involuntary muscles in the smooth working of the human body. The book is part of the "Science for Beginners" series which aims to give clear, simple explanations backed up by diagrams, photographs and comic-strip cartoons. http://www.amazon.com/Understanding-Your-Muscles-Bones-Beginners/dp/0746027397

- Muscles: Our Muscular System by Seymour Simon http://www.amazon.com/Muscles-Muscular-System-Seymour-Simon/dp/0688177204/

- Bones: Our Skeletal System by Seymour Simon http://www.amazon.com/Bones-Skeletal-System-Seymour-Simon/dp/0688177212/

Mathematics Activity:

Students can create and solve math problems using the number of parts in their aliens. Also, the number of alien parts (bones, muscles, joins, etc.) can be shown on a bar graph.

Other Follow Up Activities:

Inner Strength (National Space Biomedical Research Institute) In this activity about endoskeletons (page 8 of PDF), learners observe, compare and contrast different kinds of chicken bones, and relate their chicken bone observations to human bones. The bones must be prepared a day ahead of time. Learners also use a poem to identify the major bones of the human body and discuss the importance of bilateral symmetry. This guide includes background information, extensions, and data sheets. http://www.nsbri.org/default/Documents/EducationAndTraining/Muscles/MB_Guide.pdf#page=14

Rubber Bones (Children's Museum of Houston) Over 1 or 2 days, learners use vinegar to remove the calcium from a chicken bone. They then explore how the bones have changed. An accompanying video with Mr. O further explores the relationship between cartilage and bone and explains how bones grow. http://www.cmhoustonblog.org/2011/02/01/rubber-bones/

Bones, Muscles and How We Move

ALIEN CONSTRUCTION PROJECT

Date:

Names: 1. _____ 2. _____

3. _____ 4. _____

Project Overview: Today we will be designing a new organism, an alien… Your goal is to engineer an alien's skeleton and muscular systems, to enable motion! You have been provided with wire (bone), washers (joints), string and rubber bands (muscle). Please use this worksheet to plan your strategy. Please separate the sheets and hand them out among the group.
-You have 10 minutes!

- The first page (this one) is for writing down your ideas.
- The second page is for drawing what you *imagine* the alien's muscle and skeletal system will look like
- The third page is for when you are finished. You will draw what your constructed alien looks like when you are finished, and make several observations.

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1. How many limbs will your alien have:

2. How many heads will you alien have:

3. How many types of motion will your alien have, and what are they: (ex. Walk, fly, swim?)

4. How many joints (washers) will you need:

5. How many bones (wires) will you need:

6. How many muscles (strings or rubber bands) will you need:

7. Draw what you imagine the alien's muscle and skeletal system will look like:

Legend:

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Conclusions and Observations *(to complete at the end of class):*

8. How many joints (washers) does your alien have:

9. How many bones (wires) does your alien have:

10. How many muscles (strings or rubber bands) does your alien have:

11. How many types of motion does your alien have, and what are they:

12. Draw what your constructed alien looks like when you are finished:

Legend: