Katharine Spero

Investigating the Musculoskeletal System

Unit Description: This two week (10 days) unit teaches students about the human musculoskeletal system through inquiry. These lessons introduce 6th grade students to fundamental concepts that will be built upon in 7th and 8th grade. Each lesson is connected by questions that further students understanding of the driving question: how do I move? This unit allows students to discover important concepts about how bones, joints, muscles, and tendons produce movement. Two to three activities make up one lesson. These activities are inquiry transformations of lessons found in the FOSS and NSCR human body curriculum guides. The homework assignments are designed to prepare students for a smooth transition from one concept to the next, as they ask students to think about a question or problem that link the two concepts. The bone lesson focuses on a Owl Pellet Dissection. Students have the opportunity to develop a bone classification system, revise it, and assemble a skeleton in this lesson. I have also included a peer-assessment at the end. During the joint lesson students have the opportunity to design as full experiment from start to finish. Here learning about the joints takes place through experiential learning. However, a very important question remains; how do bones move? This leads us to a lesson that both introduces concepts about muscles and tendons and reviews what the students have learned about bones and joints. This lesson begins with the Hot Potato activity which can be used a benchmark lesson. The chicken wing dissection allows students to learn about the roles of muscles and tendons in movement, by interacting with a real a muscle and tendon. The final assessment brings all of the concepts together when students must develop and execute a plan to build a model arm.

Brief Description of Group to be Taught: This activity will be taught to two classes of sixteen 6th grade students each. Each class is made up of students with a range of ability level. There are no children on IEP in either of these classes.

Unit Concepts

Bones:

- Day 1: The size and shape of bones vary and provide clues about how to classify them.
- Day 2: Bones fit together like puzzle pieces.

Joints:

- Day 1: Movement takes place where there are joints.
- Day 2: The joint can be identified as the place where 2 bones come together.
- Day 3: Joints allow movement to take place.

Muscles, Bones, Tendons:

- Day 1: Muscles make movement happen.
- Day 2: Muscle tissue contracts to move bones.
- Day 3: Muscles are attached to bones by “connectors”

Lesson 1: Bones

Relationship of this Lesson to the unit: After learning about the digestive system, and the relationship between nutrition and energy the students posed the following question: How do I move? This becomes the driving question of the Human Musculoskeletal unit. Before this unit begins a benchmark lesson is needed to find out what students know, what they don't know, and what they want to learn. To provide a natural transition from the digestion and nutrition unit to the musculoskeletal system, the first lesson focuses on an owl pellet dissection. Students read the story "Barn Owl's" for homework the night before, which informs them about the barn owl and their pellets. It is important to note that in the 5th grade students focused on the concept that bones provide the human body with structure.

Massachusetts Frameworks Strand and Learning Standard: Life Science; 6. Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.

Nationally Validated Curriculum: FOSS

Driving Question: How do I move?

Concepts:

- Day 1: The size and shape of bones vary and provide clues about how to classify them.
- Day 2: Bones fit together like puzzle pieces.

Sub-Concepts

- Bones are rigid.
- Bones are an important part of the human body.

Processes:

- Day 1: Classifying
- Day 2: Inferring

Science Habit of Mind:

- Day 1: Seek better reasons for believing something than "Everybody knows that . . " or "I just know" and discount such reasons when given by others.
- Day 2: Different methods can produce successful results.

Day 1: Owl Pellet Dissection

Teacher Preparation:

- Order Owl Pellets in advance
- Obtain other materials

Other Subject Area Objectives:

- Language arts

Session Length: 1 hour, 1 day

Materials Needed per Group of 2:

- ❑ 9 Owl Pellets
- ❑ 4 toothpicks
- ❑ 2 pieces of wax paper
- ❑ 3 paper plates
- ❑ 2 pairs of gloves
- ❑ 1 magnifying glass

TIME	PROCEDURE	CONCEPT
10 min.	**INTRODUCTION** 1. Ask 3 students to improvise and act the story "Barn Owl" you read it aloud for the class. 2. Engage students in a discussion about what was most interesting about the story, and what was most important. Make sure students explain the "why" for each of these. Write *interesting* and *important* as the heading of 2 columns on the board, and write student's responses under these headings. If an idea is repeated place a check next to the idea already written on the board. 3. Create a concept map with students about the digestion process of the barn owl (Owl eats small rodents, cannot digest fur and bones, owl regurgitates pellet containing bones.) 4. Ask students which materials they expect to find in the owl pellets they feel is important for movement and why. Students should say the bones, but may not be able to articulate the why. If they develop questions, write these down on the chart used to keep track of questions. 5. Explain to students that they will dissect an owl pellet and their main goal is to extract the bones.	Evaluation of Story as a transition to Owl Pellet Dissection.
50 min	**DISSECTION PRODECURE** 1. Review the goal of separating the bones from the rest of the materials that make the owl pellet. 2. Let students know that everyone in the group should be recording their observations. E.g. What characteristics are important? Write you observations of these characteristics 3. Ask the Getters to get the materials 4. Ask students to: • unwrap the foil and remove the pellet.	Review of Goal and Group Tasks. Dissection steps

	• Observe the whole pellet. • Gently separate the pellet into 2 pieces. Place each piece on a paper plate so each student has a piece to work on. • Separate the bones from the fur and other material using the materials given to you. (Students should be able to figure out that they should use the toothpick and fingers as a probe without the teacher telling them.) 5. Ask students to record pellet contents. Students will be responsible for organizing their data, and choosing what is important to record. Once the activity is in progress, be sure to assess each groups organization, and focus of observations by spending some time with each group and looking at their notes. Use facilitating question if needed. In this process stress the "why", and make sure students are challenging one another to give reasons behind their methods. This relates to the science habit of mind. 6. Start Dissection!!! 7. Once all of the bones have been separated, ask students to discard fur and other material when the bones have been separated. • Clean up: Wash hand w/ soap and warm water • Throw away remaining pellet materials • Wash desks with soap and water 8. Hold a discussion about the bones. 9. Talk about what could be done next. After some discussion, students should suggest putting the bones together. 10. Ask students to first observe the bones (so they have time to think about the difference in shape and size) and then develop a classification method for separating bones. Be sure to stress that they need to explain their reasoning for the classification. Their observations should be used in this reasoning. 11. Visit each group and use facilitating questions to help them realize that they should be thinking about shape and size in relation to different body parts (e.g. the ribs should be curved, the back bone is made up of small bones). **WRAP UP AND HOMEWORK TRANSITION** 12. Bring the class together to share their method via a presentation of the chart they will use to classify bones. 13. Assess progress via student's ability to come up with a thoughtful classification method. 14. Ask students what they need to put their bones together in an accurate manner. Their classification system is most important. They will come up with many other great ideas for you to work with. 15. Clean up: Wash hand w/ soap and warm water	Task Start Dissection VISIT GROUPS Classification Method VISIT GROUPS Class Discussion Assessment Transition to HW

Facilitating Questions

Focus: Most interesting and important in the story.

- What fact was most interesting to you?
- What part of the story did you like most?
- What are the most important facts?
- What are the most important relationships?
- What might you find in an owl pellet if you dissected it?
- Which of these materials is most important to movement?
- ALWAYS FOLLOW UP WITH WHY!

Focus: Create a concept map with students about the digestion process of the barn owl (Owl eats small rodents, cannot digest fur and bones, owl regurgitates pellet containing bones.)

- What does the barn owl ingest?
- How does the barn owl digest it's food?
- How does the barn owl excrete waste?
- What makes up this waste?
- Based on what the barn owl eats, and excretes, what might you find if you dissected an owl pellet?
- If an entire rodent is consumed, then what is excreted?

Focus: Ask students to identify the most important material (bone) found in a owl pellet in relation to movement, and explain why.

- Out of all the materials you identified as excreted in the form of an owl pellet, which is most important for movement?
- What is the function of an animal's fur? Is it involved in movement? Why?
- What is the function of an animal's bone? Is the bone involved in movement? Why? How? (If this produces more questions that is ok. Write the questions in the parking lot and if the activities answer them, call the students attention to these questions. Many of these questions should be addressed by the end of the unit).

Focus: Ask students to record pellet contents. Students will be responsible for organizing their data, and choosing what is important to record.

- What do you expect to find?
- Do you think you will find anything unexpected?
- How do you plan to organize your data?
- Does this make sense to your partner?

Focus: Hold a discussion about the bones, and what could be done next.

After some discussion, students should suggest putting the bones together.

- What could we do with these bones?
- Did the story you read last night suggest anything you would be interested in doing?

Focus: Ask students to develop a classification method for separating bones. Help students realize that they should be thinking about shape and size in relation to different body parts (e.g. the ribs should be curved, the back bone is made up of small bones).

- How do you plan to classify your bones?
- How are the bones different and the same compared to one another?
- What characteristics can help you separate the bones?

Formative Assessment Questions

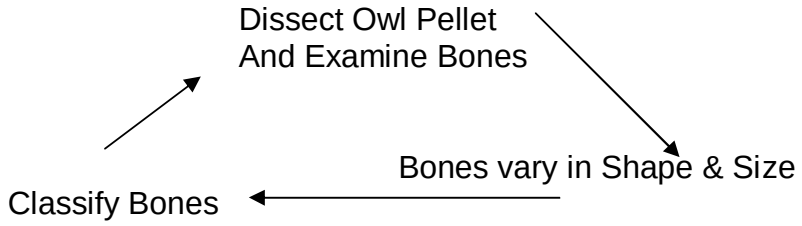
Ask students to record pellet contents. Students will be responsible for organizing their data, and choosing what is important to record. Be sure to assess each groups organization and focus of observations, by spending some time with each group and looking at their notes.

- Why did you classify the bones in this manner?
- What characteristics did you find most valuable in classifying your bones and why?
- What have you learned about bones from this activity?

Homework:

Ask students to find a picture of a rodent skeleton to use to evaluate the accuracy of their own assembly. Tell students to ignore the names of the bones, if listed. Students will have study hall on this day, so they have the opportunity to use resources such as the library and computers to complete this assignment before the day is over.

LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Classifying	Does not attempt to identify similarities and differences between bones. Has trouble with or is unable to identify important variables. Organizes bones without establishing a classification system. Recorded data is difficult for others to understand.	Is able to identify similarities & differences between bones. Identifies important classification variables. Organizes bones based on these variables. Records data in a way that is understandable to others.	Is able to identify similarities & differences between bones and makes connections to different parts of the body. Identifies important classification variables and develops classification system. Organizes bones based on these variables. Records data in a way that is understandable to others, and makes the most sense.
Habit of Mind • Seek better reasons for believing something than. "I just know".	Provides suggestions without addressing the reasons behind these suggestions.	Challenges other students to explain their reasoning in class discussion and group discussion about tasks.	Both challenges other students and themselves to explain their reasoning during class and group discussion.
Concept The size and shape of bones vary and provide clues about how to classify them.	Does not separate bones based on size or shape, or only address one of these variables.	Uses size and shape of bones to classify the rodent bones found in the pellet.	Uses size and shape of bones to classify the rodent bones found in the pellet. Also, uses these variables to predict what part of the body the different bones make up.

Barn Owls (From FOSS)

The barn owl swoops through the darn knight. It flies low over a field. It scans the ground with its sensitive eyes and listens carefully with its large ears. Suddenly the barn owl spots its favorite prey. It is a vole, a small mouse-like animal. With one quick flap of its wings, the owl is upon the vole. It gobbles the tin animal up in one bite. Without even touching the ground, the owl is off again. It has much more hunting to do before the night is over.

Barn owls are large birds with white, heart-shaped faces. They are found all over the world. Barn owls live near fields, pastures, and any place where voles and other small animals are found.

Barn owls swallow their prey whole. But they cannot digest the bones, fur, claws, and teeth of their prey. About 20 hours after feeding, barn owls regurgitate, or cough up, these bits. They comp up as oval balls of fur and bones called "owl pellets". The pellets are about 3.75 to 7.5 centimeters (1.5 to 3 inches) long.

Barn owls don't tear or chew their prey. For this reason, the pieces of a complete skeleton of a small rodent can almost always be found in a pellet. Sometimes a pellet might contain the remains of several small animals. You can use a magnifying glass and toothpicks to pull the pellet apart. Then you can put together at least one skeleton of a barn owl's meal from the pellet.

Day 2: Bone Sorting

Teacher Preparation:

- Choose a different body part for each team to observe in the introduction. A variety of body parts should be assigned so that when students come back to share they discover how the shape and size of bones can indicate different body parts.

Other Subject Area Objectives:

- Language arts (via reflection for homework)
- Art (Gallery showing)

Session Length: 2 hours, 1 day (Extra time from another teacher's class thanks to Block Scheduling!)

Materials Needed per Group of 2:

- ❑ 1 glue bottle
- ❑ 2 pieces of black construction paper
- ❑ Paper plates
- ❑ Markers/ colored pencils
- ❑ Plastic wrap (at the end)
- ❑ 8 assessment sheets

TIME	PROCEDURE	CONCEPT
20 min	**INTRODUCTION** 1. Ask students to divide into their teams of 2 and await instruction.	Bones fit together like puzzle pieces. Team

	2. Assign each team to make observations of the bones that make up different body parts by feeling their bones and imagining what they look like (inferring). Tell them to keep the variables they used in classifying bones the day before in mind to help them picture their own bones. These observations should be written down.	Observations
	3. Come together to discuss these observations. Write observations on the board. (Students should talk about the size, shape, and texture of the bones they felt).	Day 1 concept Review
	4. Reviewing the observations and ask students to consider how the characteristics they used to describe their bones relate to each body part. (Students should come to many conclusions such as the hands have small bones, the arms have long big bones, the legs have long big bones as well.) - If bones from different parts of the body are described similarly (like the arm and leg bones), challenge students to compare the two and find a difference that sets them apart from one another.	Applying Inference
	5. Ask students how they can use the same process they just used to classify their bones further (by each body part), with the end goal of assembling a rodent skeleton. 6. Write students suggestions on the board so that they can refer back to them as students assemble the skeletons.	Student Generated Classification Tips based on inferring the structure of the human body.
25 min.	**CLASSIFYING BONES**	
	7. Tell students to revise their classification system based on the discussion. (Groups will most likely focus on dividing bones based on body part). Go from group to group to observe their progress and ask facilitating questions.	Applying Inference
	8. Once this is done, ask students to compare and sort bones. - Students may find they have extra bones. Ask them why they might have extra bones. (Reason: Because more than 1 rodent was consumed.) - Be sure visit each group and answer any questions they may have (via facilitating questions).	Applying day 1 concept
	9. Bring the group together to discuss how they will proceed from here to construct the skeleton! - Go over the procedure for gluing the bones to the construction paper. - Come up with a strategy for assembly. Students may decide to assemble 1 body part at a time and then glue it before moving on to the next part. Write the procedure they come up with on the board. Ask students how they will know which bones connect with one another. They may not have an answer, but	Student Generated Construction Procedure

50 min.	ask them to pay close attention to this as they assemble their skeleton. **RECONSTRUCTING THE SKELETON** *Note: If students are really struggling with putting the skeletons together, allow each group to choose one picture of a rodent (see the previous nights homework assignment), to use as a reference. 10. Allow students to begin to reconstruct the skeleton. 11. Use facilitating questions to help students understand that bones connect at the point where they are able to fit together. Compare it to a puzzle. This is the main concept of the day, so be sure to go from group to group and use facilitating questions to help them reach an "ah ha" moment. 12. Remind students to glue the bones onto construction paper as they go. 13. Encourage students to share extra bones in order to help others complete their skeleton. 14. Have students Clean up: - Wash hand w/ soap and warm water 15. Ask students to take out the picture of a rodent skeleton they found for homework so they can use it to evaluate the accuracy of the skeleton. 16. Cover skeletons with plastic wrap as students clean up.	Use of Homework assignment in Lesson. Discovery of the main concept of the day Use of Homework assignment in Lesson.
20 Min.	GALLERY SHOW 17. Hand out 9 peer-assessment sheets to each team as you explain that a gallery show will take place and students will assess one another's skeletons based on the sheet. The assessment will be done in teams. This assessment works as an assessment tool, and highlights the fact that students may have done things differently in their organization, or final product, but there is no right or wrong answer (habit of mind). 18. Review constructive criticism vs. mean judging 19. Encourage students to be supportive and find at least one positive thing in each groups work. 20. Begin Gallery showing (This includes the skeleton, and a visual representation of the classification system). 21. End Gallery show and review homework.	Peer Assessment And Habit of mind. Presentation of Work in an artistic setting
	<u>**Facilitating Questions**</u> **Focus:** Come together to discuss the observation of different bones in the	

body. (size, shape, and texture must be discussed)

- What do you need to know in order to put your skeleton together? (Most important realization: which part of the body the bone makes up)
- What characteristics did you think were most important in describing your own bones?
- How can these characteristics give you clues about which body part the bones are a part of?
- Can this be applied to the bones in front of you?
- How might you decide which bones make up the rodents hand, leg, or backbone?
- What sets the bones apart from one another?
- How are the bones similar?
- How can you use this information to help determine where the different bones go?
- What is your goal for the bones?

- Why might you have extra bones? (This is especially useful if students are getting tripped up because they have extra bones)
- How do you know which bones are extra?
- What can you do with the extra bones?

Focus: Bring the group together to discuss how they will proceed from here in constructing skeleton!

- What do you know about your bones?
- How can you use this information to put your skeleton together?
- Where do bones fit together?
- What questions should you be asking yourselves during the construction process?
- When should you glue bones?
- What do you need to know before you glue your bones? (Students should know how the next bones connect before gluing bones to the paper.)

<u>Formative Assessment Questions</u>

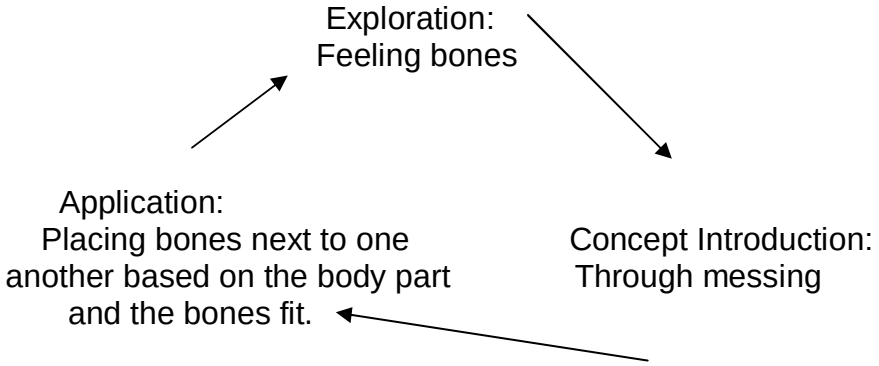
- Where do bones fit together? How do you know this?
- How did you know which bones belonged to which body part?
- Did only one method work?
- Were different methods successful? Why?

Homework:

1. In your science notebook, write a journal entry about this lesson. What worked for you? What didn't? Do you feel you have learned anything valuable? Why or why not? How did this lesson make you feel?
2. Write about what you learned about the different methods your classmates used to put the skeleton together. Did only one method work? Were different methods successful? Why?

2. On your rodent skeleton picture, circle where the animal can bend
Note: This is a benchmark assignment that assesses how easily students are able to identify joints (even though they are not aware of the name)

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Inferring	Connects feeling something hard to bone, but does not consider specific characteristics. Does not revise classification system.	Connects feeling something hard, large, small etc in own body to characteristics of bone in that body part bone. Uses this information to revise classification system of rodent bones.	Connects feeling something hard, large, small etc in own body to characteristics of bone in that body part bone. Also considers other tissue felt. Uses this information to revise classification system of rodent bones to

	Puts bones together based on their original classification system.	Puts bones together based on this classification system and criteria listed in Concept section.	classify bones based on body part. Puts bones together based on this classification system and criteria listed in Concept section.
Habit of Mind different methods can produce successful results.	The best method was x and the rest were not valuable.	Even though the teams used different methods, many were able to construct the skeleton correctly. There was not one correct method!	Even though the teams used different methods, many were able to construct the skeleton correctly. There was not one correct method! Provides and example of this in answer.
Concept Bones fit together like puzzle pieces.	Does not consider the way in which bones fit together when constructing the skeleton.	Puts bones together based on the way they fit together at the joint.	Puts bones together based on the way they fit together at the joint, and the way the body part is supposed to bend (or not).

Peer Assessment Worksheet

Name:_____ Group Assessing:_____

Classification System

What bone characteristics were considered during classification?

Was this classification system clearly organized?

Skeleton

What evidence is there for whether or not the team thought about which body part the bones were a part of before constructing the skeleton?

How does the skeleton compare to the rodent picture?

What can you learn from this group?

Lesson 2: Joints

Relationship of this Lesson to the unit: This lesson falls directly after the bones lesson in which students learn that bones come in different shapes and sizes, and fit together like puzzle pieces. The concept that bones fit together is meant to be a first step in understanding joints. The lesson about joints is introduced after a bones activity in which students assemble a rodent skeleton. Students gain experience putting bones together at the joint. The homework assignment connects the final activity with the joints lesson, as it asks students to circle where a rodent can bend, on a picture of a rodent skeleton. This leads directly into the first activity in which students review what they know about bones, consider the driving question by listing all of the places the body can move, and connect the concept that bones fit together like puzzle pieces at the joint, which means that bones come together at the joint. Day 1 of this lesson helps students connect joints with movement, and day 2 and 3 of the lesson further builds on this concept by helping students identify joints, and realize that joints allow movement to happen. These concepts are introduced through experience students' gain by designing and conducting an experiment that examines the joint's role in movement (frozen joints). Later these concepts become important in distinguishing between what makes movement happen (a muscle contracting) and what allows it to happen (a joint). The role of joints in movement is addressed in the larger picture of "how we move" in the final assessment, and concept map created by the class at the end of the unit.

Massachusetts Frameworks Strand and Learning Standard: Life Science; 6. Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.

Nationally Validated Curriculum: FOSS

Driving Question: How do I move?

Concepts:

- Day 1: Movement takes place where there are joints.
- Day 2: The joint can be identified as the place where 2 bones come together.
- Day 3: Joints allow movement to take place.

Sub-Concepts

- Human movement and structure is similar to rodent movement and structure.
- Movement is important in our daily lives

Processes:

- Day 1: Communicating
- Day 2: Identifying and controlling variables
- Day 3: Formulating Hypotheses

Science Habit of Mind:

- Day 1: View science and technology thoughtfully
- Day 2: Buttress their statements with facts found in books or articles.
- Day 3: Know how curiosity, openness, and skepticism are incorporated into the way science is carried out

Day 1 Identifying Joints

Other Subject Area Objectives:
Movement
Language Arts

Session Length: 1 hour, 1 day

Materials Needed per Group of 2:
- ❑ Completed Rodent Skeletons
- ❑ Smart Board or projection of computer image
- ❑ Internet Access

TIME	PROCEDURE	CONCEPT
15 min.	**REVIEW BONES** 1. Create sharing groups in which one student from every base group comes together to discuss what they learned during the lesson on bones. Observe each group, but do not participate in discussion. The teacher should hand out the following list of topics that the group needs to talk about and take notes on: - What do you now know about bones? - How did you classify your bones? - What did you learn from this? - How did you use the characteristics of bones as clues about how to assemble the skeleton? - What did you learn from this? - How do you think your group could improve? - What would you do differently in terms of procedure? - What do you think went really well? - What is still confusing? - What questions do you have? - How are bones involved in movement? - Where can a rodent's bones move?	Movement takes place where bones come together. Communication
15 Min.	2. Bring the class together to discuss each of these questions. - Be sure to write the answers where they can be seen. It is also important to write students answers in an order that aids in conceptualization. - Finally, to save time, when students express something ask the class to raise their hands if they agree. If the thought is totally off, ask classmates to help clarify. If the thought makes sense then move on to something *different*. Asking students to raise their hands in agreement makes them feel validated if they have come to the same conclusion and minimizes repeats.	Communication

20 min. total (5 Min.)	- This is the teachers chance to stress the most important concepts, clear up confusion, and transition to the next lesson. - The question that addresses rodents moving should be addressed last. This question will produce more questions and misconceptions than correct answers. Use these questions as motivation to learn about joints! **INTRODUCING JOINTS**	
	3. Explain that to help students understand how bones move, you want them to come up with a list of the # of different ways they can move their bodies. Allow students to work in their sharing groups, as these will become their base groups for the lesson on joints.	Experience with Concept
(15 Min.)	4. Bring the class together and ask each group to share how many different movements they discovered and to give 2 specific examples that have not already been said. Write these examples on the board.	Communicating
	5. Use the rodent skeletons and homework as references for the following discussion. Use facilitating questions to find what these movements have in common (they all occur where the bones fit together).	Concept introduction
	- Use http://www.harcourtschool.com/activity/skel.html to give students to opportunity to practice putting bones together at the joint. This will reinforce the concept that bones fit together at the joint. 6. Ask class to name the joint. Inform the class that this is called the joint directly after they name it, but tell them that when they think about the joint they should focus on the name they gave it! 7. Review homework.	Concept connection to the concept that bones fit together like puzzle pieces.
	<u>Facilitating Questions</u> **Focus:** - What do you now know about bones? - How did you classify your bones? - What did you learn from this? - How did you use the characteristics of bones as clues about how to assemble the skeleton? - What did you learn from this? - How do you think your group could improve? - What would you do differently in terms of procedure? - What do you think went really well? - What is still confusing? - What questions do you have?	

Focus:

- How many different ways can you move your body?
  - Where does you body bend?

<u>Formative Assessment Questions (To be asked during class)</u>

- Where on a skeleton can movement take place?
- Explain how bones are related to movement?
- If the body part that makes the movement did not have a joint, would movement still be possible? Why or why not?

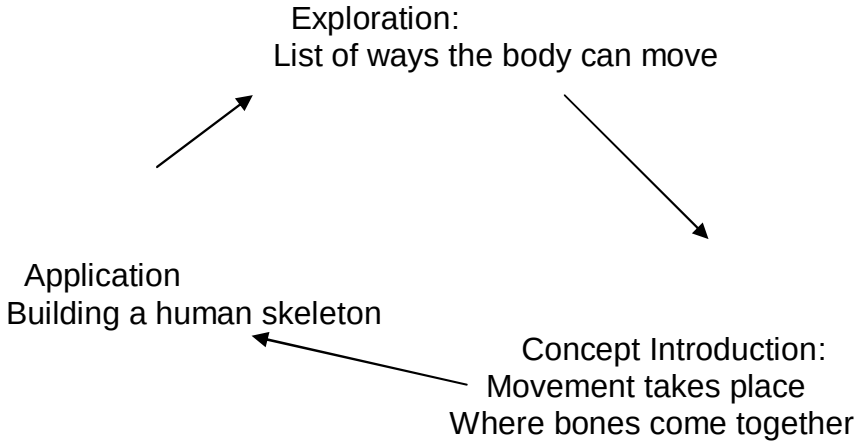
<u>Homework:</u>

Write a short story about your favorite or most useful movement and the activities or activity you use it for. Explain why this movement is so important to you. Draw a picture of the body part where this movement takes place, and circle the joint. Now, imagine that you can no longer make the important movement you described. Would you still be able to carry out the activity or activities you originally described? Why, or why not?
Extra Credit: What is the joint's role in allowing this movement to take place?

And/ or

If the body part that makes the movement did not have a joint, would movement still be possible? Why or why not?

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Communicating	Student expresses ideas with some confusing, or incompletely Student's contribution lacks substance.	Student expresses ideas clearly. Student makes a thoughtful contribution to class discussion	Student expresses ideas clearly. Student makes a thoughtful contribution to class discussion Student asks questions that take the concept further.
Habit of Mind View Science and Technology Thoughtfully	Student thinks about movement and bones separately, and does not make a connection. Student uses the internet skeleton as a review of bone concepts and is unable to connect it to movement.	Student carefully considers the connections between bones a movement Student uses the internet skeleton to further his or her understanding of motion without participating.	Student carefully considers the connections between bones a movement. Student uses the internet skeleton to further his or her understanding of motion by asking questions or making connections.
Concept Movement takes place where bones come together.	Rather than focusing on the joint, the student focuses on the entire body part that makes the movement (Circles the entire arm, rather than the elbow). This student does not know what would happen without a joint.	Student is able to identify that movement takes place where there are joint, but has trouble explaining what would happen if there was not a joint, but tries.	Student is able to identify that movement takes place where there are joint, and explains that if there is no joint, movement does not take place.

Day 2: Frozen Joints Introduction

Other Subject Area Objectives:
Music

Session Length: 1 hour, 1 day

Materials Needed per Group of 4:
- ❑ 1 Ace bandage
- ❑ Access to Sports tape
- ❑ 2 Splints
- ❑ 5 pieces of Torn cloth (that can be tied around a splint)
- ❑ 4 copies of Handouts of various joints that includes information about the joint, how it allows movement to occur, and a picture of the joint. It is important to have a variety (at least one fore each body part) because the joints students choose are unknown.
- ❑ Picture of a human skeleton

TIME	PROCEDURE	CONCEPT
15 min. Total	INTRODUCTION	The joint can be identified as the place where 2 bones come together.
(5 min)	1. Ask students to get into their new base groups, and share their stories with one another.	
(7 min)	2. Come together as a class and ask each student to demonstrate the movement he or she wrote about. Each student should also point out the joint on the picture he or she drew. - Take this opportunity to clarify where and what a joint is with students. USE RODENT SKELETONS AS A REFERENCE! By the end students should all be pointing to the joint, even if he or she did not circle the joint the night before. At the conclusion ask the students to point to the joint on their drawings at the same time (this give students the chance to affirm their understanding of the location of a joint).	Concept Introduction
(3 min.)	3. As a class discuss the extra credit questions of the homework. - What is the joint's role in allowing this movement to take place? - If the body part that makes the movement did not have a joint, would movement still be possible? Why or why not?	Taste of the next concept Review of Homework
35-40 min.	THE BEGINNING OF AN EXPERIMENT! 4. Ask each group to work together and come up with a	Making the

	movement they all enjoy doing, or feel is important. Students should have no problem with generating ideas, but might need help with making a final decision. *Warning: if students choose an action that would later require them to immobilize the knee be aware that the knee can only be immobilized when the leg is straight. If the knee is bent, then it could cause a student to loose balance and fall. Also make sure the movement is not dangerous!	experiment meaningful
	5. Walk from group to group, and evaluate their progress.	Assessment via observation
	6. Once each group comes to a decision, give them a picture of the human skeleton and ask them to identify the joint or joints that allow this movement to happen. Use facilitating question to help students with this. Also be sure to check that every team has identified the correct joint before they move on to design the experiment! - where does the body bend? Etc.	Application of Concept
	7. Explain the Frozen Joints Activity! i.e. You will create an experiment. This experiment must test how well a person is able to carry out the movement your group agreed upon, when she or he has lost the use of the joint associated with the movement. To simulate the loss of a joint, you will be asked to find a safe way (not cutting off circulation, or making it too difficult for the person to keep his or her balance) to prevent the movement using the materials on table x.	Developing an Experiment
	8. Sing Science Experiment song (you can find a song online, but it would be best if this song was written by the class on a previous date, and is now used as a reminder of how one designs an experiment.	Music
	9. Ask each group to: - Develop experimental goals - Identify variables (location of the joint, manner in which the activity is carried out, full vs partial immobilization of the joint etc.) - Decide on how to control for variables - Decide on which variables they want to manipulate. -Write a comprehensive experimental procedure that includes the above information as well as how they plan to immobilize the joint.	Identify and Control Variables
	• Be sure to check in with each group during each of these steps.	Walk around
	• If it seems like many students in the class are struggling with one or more aspects of developing this experiment, bring the scientific community back together, and work through the issue(s) through discussion.	Scientific Community
	• Encourage students to mess with the immobilization materials, but	

5 min.	don't let them use them on anyone! WRAP UP 10. If there is time, ask each group to share their experimental procedure with the rest of the class. 11. Explain homework.	Sharing of Experimental Method
	<u>Facilitating Questions</u> **Focus:** Clarify where and what a joint is with students - Where does the skeleton connect? - What bends? - Can you name any joints on your own body? - How do you know this is a joint? **Focus:** As a class discuss the extra credit questions of the homework. - What is the joint's role in allowing this movement to take place? - If the body part that makes the movement did not have a joint, would movement still be possible? Why or why not? **Focus:** Students should have no problem with movement ideas, but might need help with making a final decision. - What movements are you deciding between? - Are all of these movements safe? - What is important about each motion? - Which movement is most interesting to you and why? - What kind of a fair system can you develop to make this decision (drawing straws, voting etc.)? **Focus:** Identify the joint or joints that allow this movement to happen. - Does anything bend or extend when you practice the movement? - Does the movement create an angel out of two bones or body parts? - Compare your movement to the picture of the human skeleton. Can you find the joint in this picture? - Where is the joint in the picture located on your body? **Focus:** Developing the experiment Ask each group to: • Develop experimental goals - What do you want to learn from this experiment? - Based on what you have learned, what questions could this experiment answer?	

- Identify variables/control for variables/decide which variable to manipulate.
  - What can be changed?
  - What cannot change?
  - How many trials will you have?
  - What variables will you change in each trial?
  - Which variables must stay the same in each trial?
  - How does manipulating variables help you to answer your original questions and meet your goals?
  - Are the changes you are considering feasible?

Focus: Experimental procedure

- How will you gather baseline data?
- What data will you gather about the movement before and after the joint freezes?
- How will you organize your data?
- How many trials will you have?
- When does each trial take place?
- When will you immobilize the subjects joint?
- How do you plan to freeze the subjects joint?
- What materials will you need?
- What is the order of events?

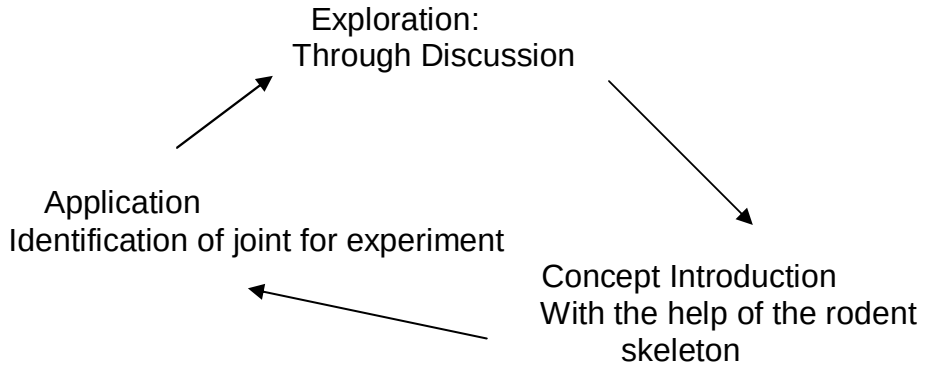
Formative Assessment Questions

Where is the joint that allows this movement located?
How do you know this is the joint?
What are the variables in your experiment? Which will you control and manipulate, and how?

Homework:

1. Read the handout about the joint that you will freeze in your experiment.
2. Write a hypothesis for your experiment. In doing this think about how freezing the joint will effect the movement. Also, consider how the variables you will manipulate influence the outcome of the experiment.

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Identifying and Controlling Variables	Have trouble identify variables and need clarification on what it means to control and manipulate variables.	Able to identify variables without help. Need some guidance in figuring out how to control and manipulate variables.	Able to identify variables without help. Are able to figure out out how to control and manipulate variables.
Habit of Mind Buttress their statements with facts found in books or articles.	Students have trouble reading the article, and understand the content of the article.	Students read and understand the article.	Students read, understand, and apply information from the article to their understanding of joints.
Concept The joint can be identified as the place where 2 bones come together.	Students understand that the joint is located at the point where two bones meet.	Students understand that the joint is located at the point where two bones fit together, and use the bones as a road map to joints.	Students understand that the joint is located at the point where two bones fit together, and use the bones as a road map to joints. Students also use movement as an indication of the location of a joint.

Day 3: Frozen Joints Experiment!

Other Subject Area Objectives:

Session Length: 1 hour, 1 day

Materials Needed per Group of 4:
- ❑ Stop watch
- ❑ 1 Ace bandage
- ❑ Access to Sports tape
- ❑ 2 Splints
- ❑ 5 pieces of Torn cloth (that can be tied around a splint)
- ❑ Picture of a human skeleton

TIME	PROCEDURE	CONCEPT
	EXPERIMENT TIME! ***IMPORTANT NOTE: The immobilization of joints will require students to engage in physical contact (between the person who will have their joint immobilized and the rest of the team). Before allowing students to begin, double check to make sure students have a non-invasive freezing procedure. Also take time to review personal space, being respectful, and communicating any feeling of discomfort immediately.**	Joints allow movement to take place.
10 min.	INTRODUCTION 1. Talk about the immobilization process and review rules of personal space. 2. Ask each tem to get together. Have them share each member's hypothesis, discuss the merits of the hypothesis, tweak them if necessary, and agree on 1 or 2 hypothesis that the team would like to adopt. 3. Ask each group to share their joint hypothesis with you. Assess each group's hypothesis. 4. Before leaving each group ask the group to decide on who will be the test subject. The test subject cannot be the getter or the recorder for this class period.	Process Skill
30 min.	FREEZING JOINTS! 5. Ask the students to carry out the first part of their experiment. This should be gathering data about their chosen movement. 6. Supervise and be available to answer questions. 7. Once each group as finished gather pre- freezing data allow the getters to retrieve the materials the group needs. 8. It is important to monitor the immobilization for inappropriate touching, tightness of immobilization (you should be able to slip your pointer finger under all	Concept Introduction via Experiment

	materials used to immobilize, look out for blue skin, and ask each student if anything hurts), and general safety. 9. If the entire class needs a reminder about a class rule, noise, or safety, then bring the entire class together to talk about what needs to change before they can finish their experiment. 10. Each group should follow their procedure and finish their experiment.	
20 min.	REFLECTION AND SHARING 11. When the actual experiment is finished, each group should talk about the results. They need to decide on what their results mean in relation to the joints role in movement, their hypothesis, and future research. They should also talk about what they would do differently next time, what worked really well, and what questions they still have. 12. Each group will give a demonstration of their movement, and explain the results with the class. They will also explain what advantages the joint they immobilized provides. The class should be encouraged to ask questions and challenge methods. 13. Each sharing is a chance for the teacher to clarify the major concept about joints: Joints allow movement to occur. 14. Summarize what is known about joints and pose the following questions: If joints simply allow movement to occur, what part of the body makes movement happen?	**Concept Clarification & Science Habit of Mind** via reflection on a produced based on curiosity Science Habit of Mind Review of what is known
	<u>Facilitating Questions</u> **Focus:** Clarify the major concept about joints - What happened to your movement when the joint was frozen? - Does the joint make movement happen? - Think about a door (draw it). • Which part is like the joint? • How does the door open and close? • Does the hinge make the door open and close? • What would happen if the door was drilled to the wall? Could it still move? • How does this relate to the joint?	

Focus: A step toward the next concept.

- If joints simply allow movement to occur, what part of the body makes movement happen?

Formative Assessment Questions

- What evidence is this hypothesis based on?
- How does this hypothesis relate to what you already know about bones and joints?
- How does this hypothesis relate to what you predict will happen in the experiment?

- What is the joint's role in movement?

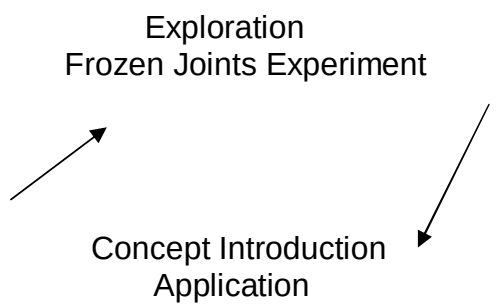
- Why did you choose to do x in your procedure?
- Could you have done x instead? How might this change the outcome?

Homework:

Write a lab report that includes the following:

- Hypothesis
- Procedure/Methods
- Analysis of Data
- Conclusion about how the data relates to the hypothesis
- Future research?

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Formulating Hypotheses	Confused reasoning is the basis of the Hypothesis. There is little connection between the Hypothesis and joint and/or bone concepts. Has trouble describing the conceptual outcome of the experiment.	Explains solid reasoning behind Hypothesis. Hypothesis is directly related to joint and/or bone concepts. Has trouble describing the conceptual outcome of the experiment.	Explains evidence the hypothesis is based on. Hypothesis is directly related to joint and bone concepts. Explains how they think the hypothesis will be confirmed in the experiment with an example.
Habit of Mind Know how curiosity, openness, and skepticism are incorporated into the way science is carried out	Lacks a feeling of accomplishment in presenting their findings. Asks questions about the concept of other presenters.	Demonstrates a feeling of accomplishment in presenting their findings. Asks challenging questions of other presenters.	Demonstrates a feeling of accomplishment in presenting their findings. Asks challenging questions of other presenters directly related to method.
Concept Joints allow movement to take place.	Confuses the joints role as making movement happen, rather than passively allowing movement to happen.	Understands that the joint only allows movement to occur and does not actively make it happen.	Understands that the joint only allows movement to occur and does not actively make it happen and questions what does make movement happen.

Lesson 3: Muscles, Bones, and Tendon Lesson

Relationship of this Lesson to the unit: The Muscles and bones lesson, is placed after the joint lesson, because the muscle is responsible for making movement happen. This is the answer to the natural question that emerges after learning about the joint's passive role in movement. The first activity serves as a benchmark activity as activities and discussion are directed by the teacher, previous concepts are reviewed (what we have learned) and new questions emerge (what do we need to know). Students will take part in a chicken wing dissection so they can see real parts of the muscular skeletal system, and manipulate these parts to move or disable the movement of a chicken wing. Students learn that muscles are responsible for causing movement because when muscle tissue contracts it move bones. This brings up an important question: how are muscles connected to bones? This is answered on day 2 of the chicken wing dissection. At the conclusion of this lesson students will have learned all of the concepts needed to understand how we move. This will be assessed the model arm activity that follows.

Massachusetts Frameworks Strand and Learning Standard: Life Science; 6. Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.

Nationally Validated Curriculum: NSCR

Driving Question: How do I move?

Question Specific to lesson: What allows the arm to bend and extend so we can play hot potato?

Concepts:
- Day 1: Muscles make movement happen.
- Day 2: Muscle tissue contracts to move bones.
- Day 3: Muscles are attached to bones by "connectors"

Sub-Concepts
- One muscle contracts to make the arm bend, and an opposing muscle contracts to make the arm extend.

Processes:
- Day 1: Observing
- Day 2: Communicating
- Day 3: Predicting

Science Habit of Mind:
- Day 1: Be careful and accurate in observations
- Day 2: Look at a matter from many sides before drawing a conclusion.
- Day 3: Day 3: Go to reliable sources for evidence. (the subject in its natural state)

Day 1 Activity: Hot Potato

Other Subject Area Objectives:

- Physical Education (movement) and Art (drawing the human arm).

Session Length: 1 hour, 1 day

Materials Needed:

- ❑ 1 Ball
- ❑ Science Notebook

TIME	PROCEDURE	CONCEPT
Day 1 5 minutes 1-2 min. 5 minutes	**INTRODUCTION** **This lesson requires the teacher to facilitate students' use of reason and logic to help them make connections between their observations of their own arms flexing and extending, and the way the arm functions.** 1. Tell students the class will play Hot Potato 2. Have students help make rules for the game (so they are more dedicated to following them) -The following rules must be stated: • Keep the noise level down • Only throw underhand • When the song stops the person holding the ball is out • No dropping the ball to avoid being the last one holding it 3. Ask students if anyone would like to sing the song that acts as the timer (this gives any students who do not want to play, the opportunity to participate in a different way). If not use a timer or the radio. 4. Play Hot Potato for 2 rounds. 5. Let the students who are out re-join the group and talk about the questions they want to answer about how they are able to play the game. **6. Ask: "What do you need to do to play this game effectively?"** 7. Brainstorm ideas and questions you want to answer such to focus ideas, or inspire participation ask students to feel their arms and talk about what they are made of. Be sure to write ideas and questions in a place where everyone can see them, so students have a visual representation of their ideas. Students questions to focus on: * What is your arm doing? - (bending and extending) * How does the arm bend? * How does the arm extend? * What are the bones doing?	Muscles cause movement.

	* What are the muscles doing? **If the students don't bring up muscles, then the teacher must ask facilitating questions to lead them to this question.** **HOT POTATO**	
	8. Table discussion, and ask each student to choose which question is most interesting to him or her. Then ask them to keep their questions in mind while playing another 3 rounds of Hot Potato.	Observation
2 minutes	9. Play Hot Potato with a focus on observation. Each students observation is focused through the questions students have brainstormed.	
	10. Ask students sit back down and give them a few minutes to write down their observations.	Recording Observations
3-5 min.	11. Discuss the students' observations in relation to what the arm is physically doing (bending and extending). Encourage students to practice the motion at their desks. Let the students name the motion, they will most likely come up with "bend" and "extend".	
5 minutes	12. Ask students to feel their own arms and name the different parts of the arm they think are necessary for the bending and extending motions to take place. • If students become overwhelmed ask them to focus on the bones first. Be sure to draw each part of the arm the students identify on the board, or to get students moving ask them to come up to the board and draw each part themselves. Always check in with the class to make sure everyone agrees. If not draw a second model that represents any alternative view. These drawings will change as the discussion progresses, until an accurate model is agreed upon by the end of the class. Students will be able to see the changes as they use logic and reason to modify their ideas. • The students should be able to name the bones abd joints as they have just learned about these. **Make sure students identify what is moving (the bones) when the arm bends and extends.** If students are missing the muscles then ask them to feel their arms again. Model feeling the arms and focus on the biceps and triceps in your own arm, so that students know where to feel their own arms. • Be sure to draw each muscle. Explain that in order to name these muscles we need to understand how they work.	
	13. Engage students in a brief discussion about the role of muscles in bending and extending the arm. This will help students define their questions and possibly create a hypothesis.	Discussion
10 min	14. Divide students into partners while at their seats. To help answer their questions or even test their hypothesis ask students to press the palm of on hand against the underside of their desks, and to feel their muscles with the other hand as the try to bend their arm.	Observation with hands on experience

	Students should feel their bicep contract as they attempt to bend the arm. Now ask students to press the back of one hand against the top of the desk while their arm is bend and then try to extend the arm (while feeling the muscles with the opposite hand). The resistance of the desk causes the muscle to work harder, making the contracted muscle easier to feel than if students were to simply bend their arms. 15. Ask students to discuss what is happening with their partners and to write in their notebooks what they as a team thinks the muscles are doing, and the evidence they have to support their theory.	
5 min.	16. Bring the class back together so that the scientific community can share their findings and engage in a discussion. Write findings down so the class can see them. Students should observe that the bicep "squeezes" or "tightens" when they attempt to bend the arm and the tricep does the same when they attempt to extend the arm. Since the muscles have not been named yet, it would be helpful to ask students to come point to the muscle they are talking about so the entire class in on the same page.	Scientific Community
3 min.	17. Ask students to take a few minutes to explore in pairs what happenes to the bicep muscle (without naming it) when you extend your arm, and what happens to the tricep muscle when you bend the arm. Students should discover that they don't do anything; specifically that they don't "tighten". Also have students observe what their muscles feel like when they let their arms dangle. Students should discover that the muscle feels "loose".	Observations
	WRAP UP	
15 min.	18. Come back together to discuss findings. Now use facilitating questions to bring out the idea that **muscles cause movement to occur through muscle contraction bones.** • Review the idea that the bones are moving. Ask students what is moving the bones. Students might name the joint, but if they do this, review that the joint is passive and it only allows the bones to move, as opposed to making them move. Once this reminder is given students should identify the muscles as being responsible for moving the bones with the following facilitating questions: What do the muscles feel like when our arm is not moving? What does this (point to bicep) muscle do when we bend our arms? What does it do when we try to extend the arm? When do you think this muscle is working? How do you think this muscle is involved in bending the arm? Repeat these questions for the tricep muscle. Students need to make the connection that when the arm is not moving the muscles feel limp, and different muscles "tighten" with different motions. When the muscle is not contracting it is not working and therefore not responsible for movement. They then need to take this a step further and understand that when muscles	Stress the first part of this as students will focus on the second part tomorrow!

	"tighten" they work to cause motion by moving bones. - Now as a class name each muscle (most likely the "bender" and the "extender")	
	<u>Facilitating Questions</u> **Focus:** Discuss the students' observations of Hot Potato in relation to what the arm is physically doing (bending and extending). What is your arm doing? (bending and extending) How does the arm bend? How does the arm extend? What are the bones doing? (moving!) What are the muscles doing? **Focus:** Ask students to feel their own arms and name the different parts of the arm they think are necessary for the bending and extending motions to take place. What do we know about the arm so far? What have we been learning about? What do you feel in your own arm? You've named x, y, and z, now what are the squishy things you felt in your arm? Does anything about this model need to be changed based on your latest observations? Does this drawing make sense given the new ideas we have just heard? What makes the bones bend? Do they move by themselves? **Focus:** Engage students in a brief discussion about the role of muscles in bending and extending the arm. What are your questions? Do you have any ideas about how the muscles in the arm are involved in bending and extending the arm? **Focus:** What happens to the muscles when the arm does not move, bends, and extends. What do the muscles feel like when our arm is not moving? What does this (point to bicep) muscle do when we bend our arms? What does it do when we try to extend the arm? When do you think this muscle is working? How do you think this muscle is involved in bending the arm?	

Focus: Name the bicep and tricep muscles.

Which muscle tightens when the arm bends?
What does this muscle do when the arm extends?
Which muscle tightens when the arm extends?
What does this muscle do when the arm bends?

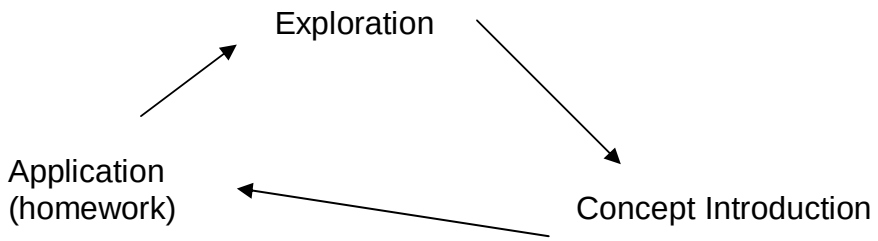
Formative Assessment Questions
How do you know a muscle is working?
How do you think this muscle is involved in bending the arm?
Which muscle tightens when the arm bends?
What does this muscle do when the arm extends?
Which muscle tightens when the arm extends?
What does this muscle do when the arm bends?

Homework:
1.) How do the bender muscle and the extender muscles work when you are throwing the ball during hot potato? Draw a picture of the parts of the arm, label each part, and describe what each muscle, the joint, and bones do when bending and extending the arm.
2.) Read the information FOSS provides about muscles. Do the answers to part 1 of your homework work given this information about muscles and the way they work in pairs? Why or why not?
3.) Read the boat accident story and answer the following questions:
How will Ned's injury affect his ability to bend or extend his arm?
Will Ned be able to play hot potato effectively with this injury?
Extra credit: What could Ned do to compensate for his injury?

- This homework assignment reinforces previous concepts of the joints, and the new concept; muscle tissue contracts to move bones.

Extra Credit (mostly for expert students):
Why do we need two muscles to bend and extend the arm rather than one?

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill **Observing**	In order to play hot potato you must throw and catch the ball. Feels arm and identifies presence of bones The muscle feels different when I try to bend or extend my arm.	The arm bends and extends while playing Hot Potato. Feels arm and identifies presence of bones and joints. When I try to bend my arm the top muscle gets hard or tightens. When I try to extend my arm this happens to the bottom muscle.	The arm bends and extends, and the brain sends signals to the arm telling it to bend or extend. Feels arm and identifies presence of bones, joints, and muscles. Takes competent a step further and finds that when the arm extends the top muscle is loose, and when the arm bends the bottom muscle is loose
Habit of Mind **Reasoning**	In order to throw a ball the arm must move. Reasons that the joint is moving. Feels arm and equates hard structure with bone. Reasons that when the muscle tightens it is working.	In order to throw a ball the arm must bend and extend. Reasons that the bones are moving. Feels arm and equates hard structure with bone, and soft tissue with muscle. Reasons that when the muscle tightens it is working. When a muscle works it causes then bones to move.	To throw a ball the arm must bend and extend, and to aim for a person the arm must rotate. Reasons that the joints are allowing the bones to move. Takes this a step further and inquires about tendons in arm, because these feel hard but are flexible, which does not fit the characteristics of bone or muscle. Takes competent a step further and reasons that something must pull on the bones to make them move. Therefore the muscles must be attached to the bones.

Concept **Muscles contract to move bones.**	Muscles make an arm bend and extend.	Muscles contract, which moves bones, therefore creating movement.	Muscles contract to move bones, and never stretch which is the reason two opposing muscles are needed to bend and extend the human arm.

A Brush with Death

Directions: Please read the passage below and answer the questions that follow in your notebook.

Lonnie and his friends are out boating on a beautiful sunny summer day. They have been tubing and swimming all day long. The sun will be setting soon and they need to get the boat back to the dock before nightfall. Lonnie has swam pretty far from the boat and as he swims back he begins to wrap a rope that is attached to the boat and floating in the water in circles around his right arm so it wont get tangled when they pull the rope back to the boat. In their rush to get home Lonnie's friends don't realize he is still in the water and they take off. The rope that is attached to Lonnie's arm gets tighter and begins to unravel. The faster the boat goes, the faster the rope unravels, causing the rope to cut through Lonnie's arm. As quickly as he can, Lonnie tries to unwrap the rope from his arm. He is able to get the rope off, but not before it has done permanent damage. As soon as Lonnie's friends realize what is happening they stop the boat, help Lonnie out of the water and call for help. Luckily, Lonnie did not lose his life, but he did lose his bender muscle. The rope cut right through the bender muscle, and since muscle tissue does not grow back, he lost the use of this muscle. Lonnie is right handed, so he will have to find some way to compensate for the injury to his right bender muscle.

How will Ned's injury affect his ability to bend or extend his arm?

Will Ned be able to play hot potato effectively with this injury?

Extra credit: What could Ned do to compensate for his injury?

Muscles

Your body has more than 700 muscles. Without these muscles, you'd be going nowhere! Every move you make is powered by muscles. Muscles help you walk, run, and play hot potato. When you blink, chew, or talk you are using muscles. Muscles also help keep your body upright and make your movements steady.

Muscles are made up of small, thick bundles of fibers. These fibers are designed for movement. When muscles contract, or shorten, they pull the bones causing movement.

About 650 of your muscles are skeletal muscles. Skeletal muscles move the arms, legs, and other parts of the body. Skeletal muscles are also called voluntary muscles. That's because you can control these muscles.

Muscle Pairs

Skeletal muscles nearly always work in pairs or groups. While one muscle contracts, the other one relaxes. Look at your upper arm as you bend your arm at the elbow. The biceps and triceps muscles in your upper arm are working together. The biceps contracts and becomes shorter, while the triceps relaxes and becomes longer.

It is important to take care of your muscles. This means getting plenty of exercise and eating well. The more your muscles are used. The better they will work.

Day 2 Activity: Chicken Wing Dissection

Other Subject Area Objectives:

- Language arts.

Session Length: 1 hour, 1 day

Teacher Preparation:

- Bring 2 trash bags to dispose of chicken wing scraps asap after the class is over.
- Keep wings refrigerates
- Make sure students have access to a sink and soap.
- Pre-set the dissection tools, paper towels, marker, and paper plates.

Materials Needed per group of 2:

- ❑ 2 Safety goggles
- ❑ 2 Probes
- ❑ 1 Scalpel
- ❑ 1 Scissors
- ❑ 2 pairs of Gloves
- ❑ 2 Tweezers
- ❑ 1 Dissection tray
- ❑ 2 Paper plate for waste
- ❑ 6 sheets of Paper towel
- ❑ 1 marker

TIME	PROCEDURE	CONCEPT
10 min.	**INTRODUCTION** 1. Check to make sure homework is complete since it will not be discussed at the beginning of class. 2. Tell students they will have the opportunity to see a muscle because they will be dissecting a chicken wing today! Reassure them that if they do not want to dissect the wing they don't have to, but they still need to participate verbally. 3. Review safety and clean up: - Goggles - Gloves - Safety with sharp objects - No touching hands to mouth - Taking turns - Washing dissecting utensils - Washing hands with soap Give students guidance for removing skin- this is very difficult, students need to be reassured. 4. Explain that since their hands will be full of chicken matter, they will not be taking physical notes as they go, but will be expected to write all of the observations down right after they clean up, so they don't forget anything. 5. Review that the goal of the dissection today is to find the muscle 6. Reason through the dissection procedure before beginning the dissection. Write this procedure on the board. - Cut through skin *Where is your muscle located? *What is covering the muscle? (skin) - Find muscle - Make the muscle bend or extend the chicken wing. *When muscles contract what happens? *How could you re-create this in the chicken wing?	When muscles contract they move bones.
40 min.	**BEGIN DISSECTION!** 7. Tell students to get into their groups of 2 8. Ask the getters to come get the chicken wing. (the dissection tools, paper towels, and paper plates should be pre-set) 9. Have students write their group name, and class period on the plastic bag of the chicken wing so they can retrieve the same wing the next day. 10. Remind students to ask questions if they have them. 11. Allow the students to begin and remind them to refer to the board if they forget what comes next.	

10 min.	12. Travel from group to group and always be aware of safety. 13. The fat under the skin makes the chicken wing slippery. Have the getter rinse the chicken wing with soapy water if the wing is too slippery. 14. Many students will cut through the skin too carefully, or cut with the dull part of the scalpel. Be prepared to demonstrate how to use the scalpel (the sharpest point is the tip), and cut the skin (hold skin taught with one hand and cut with the other). Students may also not realize that they can cut the skin with scissors. Remind students to think about how they can use all of their tools during the dissection. 15. Once students cut through the skin, they may not realize that the pink stuff under the skin is a muscle! Use facilitating questions to help them identify the muscle. 16. Students need to clear away as much skin as possible before they will be able to squeeze the muscle (make it contract), and make the chicken wing flap. Many students will simple move the bones of the wing to create this motion. Use facilitating questions to help them realize why this is incorrect, and how they should be doing based on what they have learned. **WRAP UP** 17. Clean Up 18. Write Observations 19. Review Homework	
	<u>Facilitating Questions</u> **Focus:** Cut through skin and locate muscle. - Where is your muscle located? - What is covering the muscle? (skin) **Focus:** Make the muscle bend or extend the chicken wing. - When muscles contract what happens? - How could you re-create this in the chicken wing? Once students cut through the skin, they may not realize that the pink stuff **<u>Formative Assessment Questions</u>** - What is the muscles role in movement?	

- How does the joint, muscles, and bone work together to enable movement to occur?

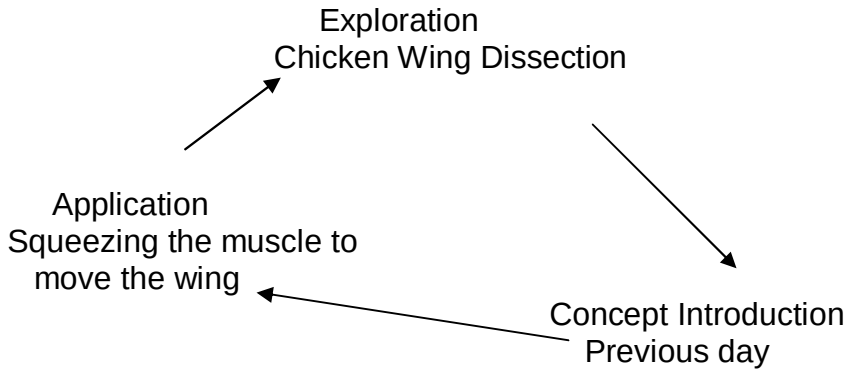
- How do your observations from the previous activity and the chicken wing dissection support or refute the idea that when muscles contract they move bones?

Homework:

1. Finish writing observations and answer the following questions:
   - What did you have to do to reproduce the flapping motion of a chicken wing?
   - How does this relate the way in which the arm bends and extends?

2. Write a creative story about something that is connected to something else. Remember that a story has a beginning, and middle, and an end. The "something" and "connector" can be completely make up, or real! Make sure your story addresses the following questions:
What are the items that are connected?
Why are they important or interesting?
What connects these items?
What would happen if there was no connection, or the connection was broken?

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill			

Communication	Students have trouble communicating effectively, and fun into safety issues.	Students communicate about safety and concepts well.	Students communicate about safety and concepts well. These students also ask thoughtful questions about movement based on what they see.
Habit of Mind Look at a matter from many sides before drawing a conclusion	Students have trouble relating the dissection to the concept.	Students use examples of what they have learned from the dissection to inform their understanding of the muscles role in movement.	Students use examples of what they have learned from the previous day's activities as well as the dissection to inform their understanding of the muscles role in movement.
Concept When muscles contract they move bones.	Students confuse the joint as the cause of movement, and are not clear on the muscle's role.	Students understand that the contraction of the muscle causes movement to occur.	Students understand that the contraction of the muscle causes, bones to move, and the joint allows these bones to move.

Day 3 Chicken Wing Dissection Continued

Other Subject Area Objectives:
Language arts
Performing arts

Session Length: 1 hour, 1 day

Teacher Preparation:

- Bring 2 trash bags to dispose of chicken wing scraps asap after the class is over.
- Keep wings refrigerates
- Make sure students have access to a sink and soap.
- Pre-set the dissection tools, paper towels, marker, and paper plates.

Materials Needed per group of 2:

- ❑ 2 Safety goggles
- ❑ 2 Probes
- ❑ 1 Scalpel
- ❑ 1 Scissors
- ❑ 2 pairs of Gloves
- ❑ 2 Tweezers
- ❑ 1 Dissection tray

- ❑ 2 Paper plate for waste
- ❑ 6 sheets of Paper towel

TIME	PROCEDURE	CONCEPT
8 min.	INTRODUCTION 1. Divide the class into groups of 3. 2. Ask each student to give a brief synopsis of his or her story to the group. 3. Model a synopsis and identify that you are telling the main ideas of the story that explain the beginning, middle, and end. 4. Tell each group to choose one story (via an anonymous vote) that the group will perform while someone narrates the story (this can be the teacher or and student(s) who feel uncomfortable performing. 5. Allow the students to develop and practice a performance. Use facilitating questions to help students figure out how to act the story out. Many students wont realize that they can perform as objects or scenery as well as people!	Muscles and bones need to be connected in order for movement to occur.
20 min.	PERFORMANCE 6. Ask students to sit down and review "good audience" guidelines. 7. Do a curtain up and down for each performance. 8. Clap after each performance. 9. Write the important points of the story on the board after each performance. 10. After all of the performances are over hold a discussion in which students realize: - Two items can only be linked if they are connected by something. - If the connector is broken or does not exist, then the entire machine no longer works properly. - Something needs to connect the muscle to the bone. (Review that bones move when muscles contract) (If you ask students how the bone moves when the muscle contracts, they will most likely say that it pulls on the bone. If you ask the students how the muscle pulls on the bone, they will come to the realization that it needs a connector. Drawing a picture on the board helps.) 11. Ask the class to name the connector (they will most likely say "connector") 12. Ask the students to draw where they think the connector is located. i.e. where is connects to the muscle, and where it connects to the bone.	Performing Arts
	13. There should be a misconception here. Some, if not all students	Predicting

	will draw the connector from the muscle to the joint rather than the bone. If this happens, do not correct students. Make it a hypothesis that will be tested during the next phase of the dissection. Ask if there are any other ways the muscle could be connected to the bone.	
30 min	DISSECTION 14. Create a dissection procedure that will test the hypothesis. - Where should you look? - How can you test to make sure you have found the connector? (cut the connector, and try to see if the wing will still flap when someone squeezed the muscle.) 15. Review safety and clean up rules from the previous day. 16. Allow students to begin the dissection. 17. Travel from group to group and always be aware of safety. 18. Help students identify the tendon or connector 19. The students should squeeze the muscle and make the wing move once more. 20. Ask students to predict what would happen the connector were cut. 21. Have the students cut the connector and squeeze the muscle once more. (This is where students realize that the muscle needs to be connected to the bone for movement to take place!) 22. If any group is ahead, help them find the joint, allow them to tear the chicken wing apart, and cut a bone in half for them to look at. 23. Once everyone has found and tested the connector, ask everyone to clean up. 24. Bring the class back together to discuss how their findings relate to the hypothesis. 25. Revise the drawing of the connector so that it is correct. 26. Name the connector as the tendon.	Habit of Mind: Consult a reliable source Concept Introduction Predicting and Concept Application.
2.min.	WRAP UP 27. Review what you have learned about muscles and tendons. 28. Explain homework.	
	<u>Facilitating Questions</u> **Focus:** Use facilitating questions to help students figure out how to act the story out. - Who are the main characters? - Does the setting play a large role? - Are there any important objects you could act out in the story?	

Focus: Finding the Connector

- Where should you look?
- What is the connector attached to?
- How can you test to make sure you have found the connector?

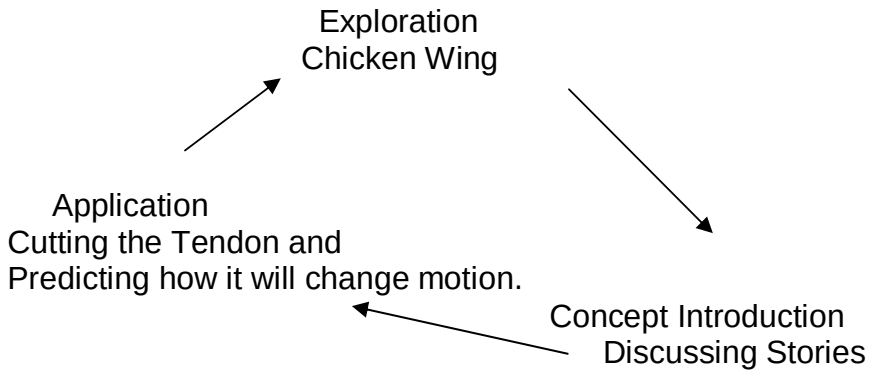
Formative Assessment Questions

- What do you think will happen when the connector is cut and you squeeze the muscle? Why?
- Why is it valuable to explore a chicken wing?
- Why is the connector needed?

Homework:

Review what you have learned so far and reflect on your understanding of how we move. Use what you have learned to explain how any body part other than the arm moves. Do you still have questions? Are you confused about anything? What do you feel like you understand so well you could teach it to someone else? Be ready to share your reflections in class.

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Predicting	Has trouble predicting and falls back on the answer that nothing will change	Is able to predict that something will change with the connector is cut and acknowledges that is plays a role in	Is able to predict that that the chicken wing will not move when connector is cut and explains that without the connection the

		movement.	muscle cannot pull on the bone to cause movement.
Habit of Mind Go to reliable sources for evidence	Is not sure if the chicken wing is a good source.	Identifies the chicken wing as a good source for evidence but cannot articulate why.	Identifies the chicken wing as a good source for evidence, and explain that it allows them to the parts of the body in their natural state.
Concept	Does not understand that without the connector movement could not happen.	Understands that the connector is essential in allowing movement to occur.	Understands that the connector is essential in allowing movement to occur and explains that without the connection, the muscle cannot pull on the bone to cause movement.

Final Assessment: Constructing a Model Arm

Relationship of this Lesson to the unit: Now that students have an understanding of all the concepts necessary for understanding the human musculoskeletal systems role in movement, its time to bring the concepts together, and test students understanding! The first day this assessment gives students the opportunity to make connections between the unit concepts, through the thoughtful process of creating a blue print. Students must think about what each material represents in the human body, and how they interact to make the arm bend. The second day of this assessment is the construction phase. The students final product, as well as their demonstration of how the arm bends will be assessed. It is vital that each student leaves this final day understanding that the muscle causes the movement to occur (demonstrated by pulling on the rubber band of the arm).

Massachusetts Frameworks Strand and Learning Standard: Life Science; 6. Identify the general functions of the major systems of the human body (digestion, respiration, reproduction, circulation, excretion, protection from disease, and movement, control, and coordination) and describe ways that these systems interact with each other.

Nationally Validated Curriculum: FOSS

Driving Question: How do I move?

Assessment Goals:

- Day 1:
  - Understands that each piece of construction material represents a part of the human arm.
  - Correctly identifies what each material represents in the human arm.
  - Is able to create a plan that describes how the bones, joint, muscle, and tendon works together to produce movement (the arm bending)
- Day 2:
  - Revises construction method based on experimentation.
  - Is able to correctly assemble the model arm.
  - Makes the arm bend by pulling on the rubber band (muscle contracting) rather than moving the wooden dowels (bones moving).

Processes:

Day 1: Communicating
Day 2: Making a Model

Science Habit of Mind:

- Day 1: Making Connections between Concepts
- Day 2: Applying Connected Concepts

Day 1: Creating a Blue Print

Other Subject Area Objectives:
Engineering
Art

Session Length: 1 hour, 1 day

Teacher Preparation: Practice making the arm model

a. Connect 2 dowels (upper and lower arm bones). The sticks should be pushed into the rubber tube (elbow joint) until they touch. The holes in the dowels should be aligned directly over one another.
b. Open up 2 paper clips to make C hooks. The smaller hook of the C attaches to the rubber band (muscle); the larger attaches through a hole in the dowel.
c. Use the paper-clip tendon to attach one large rubber band from the upper arm to the top of the lower arm.
d. To create triceps add 2 more paper clips, and attach another rubber band to these paper clips, opposite the biceps rubber band.

Materials Needed per Group of 2:

- ❑ 2 wooden dowels
- ❑ 1 rubber tube
- ❑ 4 paper clips
- ❑ 2 rubber bands
- ❑ 2 large (poster size) pieces of paper
- ❑ access to markers and colored pencils

TIME	PROCEDURE	CONCEPT
10 min.	**INTRODUCTION**	Connecting Unit Concepts
	1. Review homework with the entire class and therefore important concepts. Make sure everyone shares. Clear up confusion.	What is Known
	2. Describe Model Arm Challenge and connect it to construction - Bring out the materials. Present the challenge of assembling a model arm that can bend. Teams may attempt to add to the model so it will extend for extra credit. - Explain that today is the planning phase and tomorrow construction will commence. This means that students cannot attempt to put the arm together today!!! - Tell students to use the notes all over the room (notes from previous classes must be hung around the room) as a reference.	Challenge
	3. The task of the day is to create a Blue Print of how they will use the materials to build a model arm. Explain what a Blue Print is (a visual plan that shows how to put materials together to create a structure).	
	4. Each Blue Print should include: - A drawing of each material used. - A drawing of how the materials fit together - A key that explains what each material represents in the human arm. - A drawing of how these materials need to be manipulated to create the desired effect (the arm to bend)	Instructions

40 min	**PLANING CONSTRUCTION** 5. On a table, lay out all of the materials for the entire class. 6. Explain that the students will not be told which materials or how much of each they will need to use (this will require the teacher to have extra materials in case some groups take more than they need of one thing). They must take an inventory of the materials and decide on how to use them. 7. Ask each group to take turns (2 at a time) taking an inventory of the materials. 8. Each group should then talk about how they can use the materials to create a working model of the human arm. From this point on, only the getter is allowed to retrieve materials to look at during planning. 9. Before creating a Blue Print, each team's reporter must present the teacher with a construction proposal that includes their procedure and the layout of what their Blue Print will look like. (This is the teachers chance to use facilitating questions to help students use reason to reconsider poor choices) 10. Once each proposal has been revised allow students to create a Blue Print.	Making Connections Materials Represent part of Human Arm Art and Engineering
10 min.	**WRAP UP** 11. Clean up. Getters put materials back. 12. Ask each team to give a brief 2-3 minutes presentation of the Blue Pint. Allow the class to ask questions and make suggestions. 13. Review Homework	
	<u>Facilitating Questions</u> **Focus:** Materials as parts of arm - What is the end product supposed to be? - How are these pieces connected to the arm? - What characteristics of each material are similar to the parts of the human arm?	

Focus: How it all works

- How do the muscles, bones, joint, and tendons work together to create movement?
- What are each parts individual roles?
- How do they work together?
- How does an arm bend?

Formative Assessment Questions

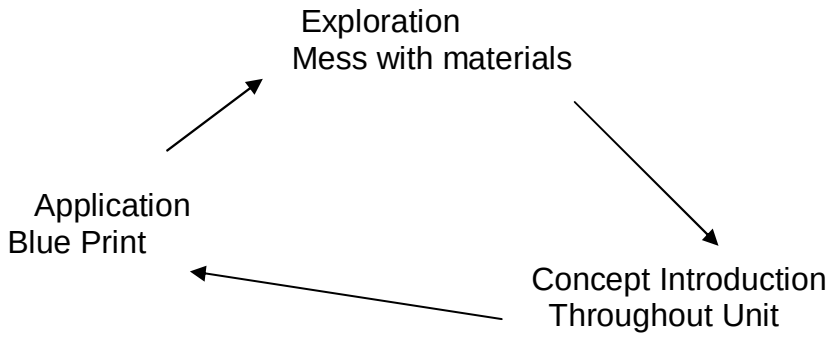
Assess blue print for:

- Understands that each piece of construction material represents a part of the human arm.
- Correctly identifies what each material represents in the human arm.
- Is able to create a plan that describes how the bones, joint, muscle, and tendon works together to produce movement (the arm bending)

Homework:

Write a paragraph that explains how the bones, joint, muscle, and tendons work together to make movement happen.

In other words, the LEARNING CYCLE



	Novice	Competent	Expert
Process Skill Communicating	Communicates ideas to teammates without evidence from what they have learned to support ideas.	Effectively communicates ideas to teammates with evidence from what they have learned to support ideas.	Effectively communicates ideas to teammates with evidence from what they have learned to support ideas. Challenges others and asks thoughtful questions.
Habit of Mind Making Connections between concepts	Connect some of the concepts of the unit, and needs clarification on a few concepts.	Connect most of the concepts of the unit to create a clear concept of how we move.	Connects all of the concepts of the unit, and uses specific examples from lessons to create a clear concept of how we move.
Concept How we move!	Understands that the muscle, joints, tendons, and bones are needed to produce movement. Understands that bones move, but are unclear about what makes the bones move (the joint or muscles). Is still unclear about where the tendon connects, or how it pulls on bones.	Understands that in order for movement to take place the muscle must contract. When the muscle contracts, it shortens and pulls on the tendon that is attached to bone. The tendon pulls on the bone. The bone moves, because it is connects at the joint, which allows movement to take place.	Understands that in order for movement to take place a person must ingest nutrients that are turned into energy. This energy is used to make the muscle contract. When the muscle contracts, it shortens and pulls on the tendon that is attached to bone. The tendon pulls on the bone. The bone moves, because it is connects at the joint, which allows movement to take place.

Day 2: Construction of the Model Arm

Other Subject Area Objectives:

Session Length: 1 hour, 1 day

Materials Needed per Group of 2:
- ❑ 2 wooden dowels
- ❑ 1 rubber tube
- ❑ 4 paper clips

- ❑ 2 rubber bands

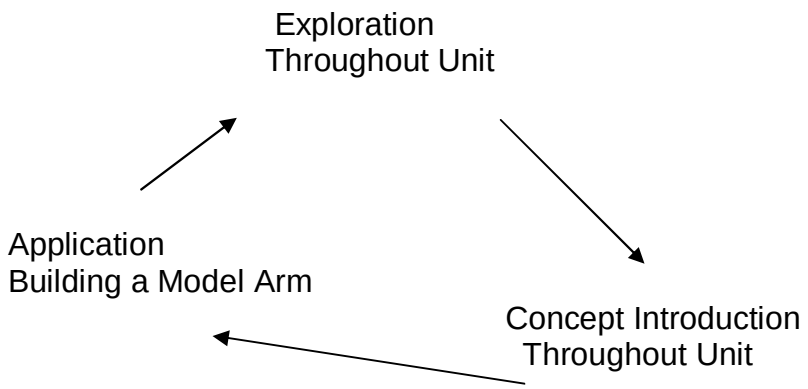
TIME	PROCEDURE	CONCEPT
5 min.	**INTRODUCTION** 1. Check to make sure homework is complete since it will not be discussed at the beginning of class. 2. Review the task of the day: a. Using your Blue Print as a guide construct a model arm that can bend. Teams may attempt to add to the model so it will extend for extra credit. b. Explain that today is the construction phase. This means that students will attempt to put the arm together today!!! When students get into their teams the getters may get only the materials listen on the blue print. c. Tell students that they are allowed to improvise, or deviate from their plans if they find that something does not work. Reassure them that this is part of the process, and it happens all the time. If they are having trouble, the questioner should ask the teacher for help. Before getting help the team needs to talk about what is and is not working. d. Each team must show the arm bend, before they can attempt to make it extend by adding more materials.	Applying Connections Review Task
35 min.	**CONSTRUCTION!** **Note:** The amount of time it will take groups to complete the task will vary. If some groups finish ahead of others, encourage them to attempt to build the extender muscle. If a few teams complete this and other teams still need more time, ask them to do research (look through books around the room) about the actual names of the muscles in the arm. 3. Allow students to begin construction. 4. Travel from group to group and use facilitating questions to help them. Keep in mind that this is the final assessment and students should be able to work through most issues with one another at this point. If one team does not understand something that another team does, ask the teams to come together. 5. Be sure to check each team's model. This is the assessment. The goal is not simply for the arm to bend, but for the students to demonstrate this by pulling on (contracting) the rubber band (muscle). Some teams will simply hold the wooden dowels and bend them. This is where the "ah ha" moment comes for students who have not made the connections between each concept. Use facilitating questions to help them come to the following	 Concept Clarification!

	understanding: ❑ Bones come together at the joint. The joint allows the arm to bend, because bones can move at the joint. But, it is the muscle that **makes** the arm bend because when it contracts (or shortens/tightens) it pulls on the tendons which are connected to the bones. The tendons pull on the bones and make them move. This can be applied to every moving body part! This is how we move!	
20 min.	6. When the teams are finished ask them to write their names on a piece of paper and then place their model on top of the paper. This way the teacher can assess the models in full after the bell rings.	
	WRAP UP	Concept Map
	7. Create a concept map of the connection the model arm brings together for the students. 8. Tell the students the actual names of the joint, muscles, and tendon.	
	9. Celebrate with trivia or the students favorite classroom game!	Celebrate
	10. When students leave, assess the final product in relation to the blue print. The planning and way in which the model was constructed can tell the teacher a great deal about - How students modified their Blue Print. - Which concepts they understood. - Which concepts they had trouble understanding.	Assess Models
	<u>Facilitating Questions</u> **Focus:** Making Connections - What does the x (use for all materials) represent in the arm? - What role does this play in producing movement in your model arm? - What would happen in x piece were missing? **<u>Formative Assessment Criteria</u>** - Revises construction method based on experimentation. - Is able to correctly assemble the model arm. - Makes the arm bend by pulling on the rubber band (muscle contracting) rather than moving the wooden dowels (bones moving).	

Homework:

Write instructions about how to make the model. Explain how the model represents the different parts of the human arm, and the way the bicep makes the human arm bend. Do these instructions match your Blue Print or did you have to change something during construction? Explain.

In other words, the LEARNING CYCLE



	Novice	**Competent**	**Expert**
Process Skill Making a model	Constructs a model with many errors and model does not bend.	Constructs a working model with a few small errors.	Constructs a working model correctly.
Habit of Mind Appling Connections	Model does not work on the first try, but given some extra time and guidance they are able to create a working model.	Pulls on rubber band first, and then the rubber band. Students have an "ah ha" moment and their confusion is cleared.	Pulls on rubber band on the first try.
Concept How We Move	Same as day 1	Same as day 1	Same as day 1

Unit Reflections

What went well with the Unit?

The highlight of the unit for me, was creating a natural flow in the presentation of concepts. I was able to do this through fantastic inquiry activities, as well as homework assignments that required students to take their understanding of a concept and stretch it a bit by thinking about a question that, when answered, would build upon their understanding of how we move. This driving question, helped me to keep each lesson, concept, and activity connected. The concept map we were asked to create, gave me an excellent reference for the big picture. This allowed me to create detailed lessons that tied into the big picture of how the bones, joints, muscles, and tendons work together to produce movement.

I also enjoyed creating activities that would engage students in the scientific process. I took every opportunity to allow the students to dictate the development of the experiment. I also felt movement was important, as 6th graders are full of energy and need to move as possible. This is the reason I chose to have them play hot potato, and create an experiment that centered on movement. A marriage between exploration and discussion should help students come to an in depth understanding of each concept. Using creativity in a thoughtful way was my motto in developing the unit!

What did I learn from doing this Unit?

First and foremost I learned that it is essential to plan ahead in teaching! This unit plan took a great deal of time and energy. While it probably took longer for me because I have never done this before, I am sure this is not something even experienced teachers could complete in a few days. Thanks to this experience I have vowed to always be a unit ahead in my planning. I also learned that it is very difficult to estimate how much time an activity will take without trying it! I feel like my time estimates throughout this unit will need to be revised once someone actually tries to teach the entire thing. In the process of planning this unit, I was able to see how important it is for concepts to be connected by a driving question. This allows students and the teacher to present the concepts in a united manner.

How would I change this Unit?

Before I changed anything I would try to teach this entire lesson, as I found the experience of teaching two of the activities to be extremely valuable. I do have some inklings about things that need to be modified. The connections between each concept should be said explicitly by the teacher, just to make sure the experiential learning is translated. I would also connect more concepts in this unit to the previous and coming units. I was thinking more about transition than I was about integrating concepts from other lessons. This is a mindset I will change in the future.

Reflections Based on Teaching the Hot Potato/ Model Arm Activity:

When I taught the model activity I scrunched the hot potato activity, and construction of the model arm into one day! While I was able to fit it all in, I didn't feel like students had the opportunity to gain a deep understanding of the man concept: Muscles contract to create movement. During the Hot Potato activity the students and I engaged in an unexpected discussion about the bones and joints. As we were talking about the muscles role in movement, many misconceptions about the joints role in movement surfaced. Students thought that the joint made the arm move. To help clarify the confusion I decided to draw a picture of the arm and asked students to come up to the board and draw the different parts. They had some trouble with this, so I asked them to feel their arms and look for their bones. We identified the different parts of the human arm and students drew them on the board. We used this visual to talk about how the arm moves, and referred back to it each time we gained new information from an experience (feeling muscle while trying to bend or extend the arm). This discussion went 10 minutes over what I had planned and I had to cut it short.

This experience was very informative. I learned that the hot potato activity should be given a full day to get the most out of it in terms of student's understanding of concepts, as is reflected in this unit plan. I also realized that students were confused about the joints role in movement. Many students thought that the joint played an active role, rather than passive. I felt it was essential to teach students about joints before introducing concepts about muscles, which helped determine the order in which the lessons are arranged for this unit.

Rather than tell students they were wrong, I decided to let them find out when they built their model arm. Students were given the correct number of each material before they began. No plan was made about how to construct the model, students just went into it, and we came together as a class to share methods during the activity. Most students immediately started putting the materials together without actively thinking about how the materials were related to the human arm. When students constructed the arm and I asked them to show me how it worked, most of them held the wooden dowels and moved the arm. At that moment I took the opportunity to give students an "ah ha" moment. I asked them to think back to the hot potato activity, and used facilitating questions to get them to focus on the muscles role in moving the arm. I asked if they could make muscle tighten. First, many students said "oh this is supposed to be the muscle?" Then they pulled on the muscle and watched the arm bend. A light went off; I could see it in their eyes. Before we had time to discuss the activity as a class the bell rang and the students had to leave.

The fact that after students had constructed their models, they didn't know that the rubber band was supposed to be the muscle, told me that students needed to make these connections before building the model. So, I decided to split the model arm activity into two days; one day for planning and one for building. The fact that building the model arm can be a review of each of the unit concepts, and an assessment drove me to use it as the assessment at the end of the unit.

Reflections Based on Teaching the Chicken Wing Dissection:

This was my first time teaching a dissection, so I was not quite sure of how to turn it into an inquiry lesson. It was a real cook book lesson. The instructions were laid out for students, and all they had to do was follow them. I led an introduction in which we drew the arm and talked about the connector and where it went. Many students thought the tendon connected to the joint. The one thing I did to transform it when I taught the lesson was not allow students to look at the instructions. They had to

make it up as they went along. This didn't seem to be a problem at all. What was a problem was timing. There simply was not enough of it for students to dissect the chicken wing, really explore the muscle and tendon, and reflect on what they had learned. So, the first think I decided to do was split this lesson up into two days.

The next task was turning this cookbook lesson into an inquiry lesson. First, I identified the concepts I wanted the students to learn. They were to learn that when muscles contract they move bones, and the tendon connects the muscle to the bones. Then I needed to find a way to make this interesting to students. The students' interest in muscles was already peaked from the hot potato lesson. I sparked an interest in the tendon by assigning homework that asked students to write a story. The beginning of the second day of dissection begins with a performance of a few of these stories. Now that students were excited about learning, I had to find a way to get them directly involved in planning the dissection, and connecting the concepts to the dissection. To do this I ask the students to develop a hypothesis about the way the muscle and tendon (on their respective days) works, and then create a class procedure for testing this hypothesis through the chicken wing dissection. This procedure is written on the board, and students then test their hypothesis by squeezing the muscle to make the wing flap, and cutting the tendon to see if movement will occur when the muscle is not connected to the bone.

If I had More Time:

After exploring PASCO's website I found a human arm model that gathers data about elbow joint movement and muscle tension. The model can also show how the triceps and biceps muscles contract to cause motion, which is the first concept introduced to students about muscles in my unit! The model arm can actually throw a ball, which relates back to the hot potato activity in my unit plan. While I won't be able to include this probe in my unit plan now, I will do so if I ever have the opportunity to work with a model arm in my classroom, I will most definitely use it to teach students about the human musculoskeletal system, as well as force and motion.