Setting Things in Motion

Unit 1

This slide deck is intended to help guide you and your students through the sequence of this unit. While you may choose to use these slides as a helpful tool to prompt and facilitate students, all detailed information for each unit is in the student and teacher unit booklets.

Unit Essential Question

How do our bodies produce and use the energy needed to move objects?

Objects in Motion

Lift-Off Task

Kicking a Kickball

Kicking a Kickball

Every day, we make objects move without thinking twice about how it works!

- Go outside and observe different classmates kicking a kickball.
- What do you notice?

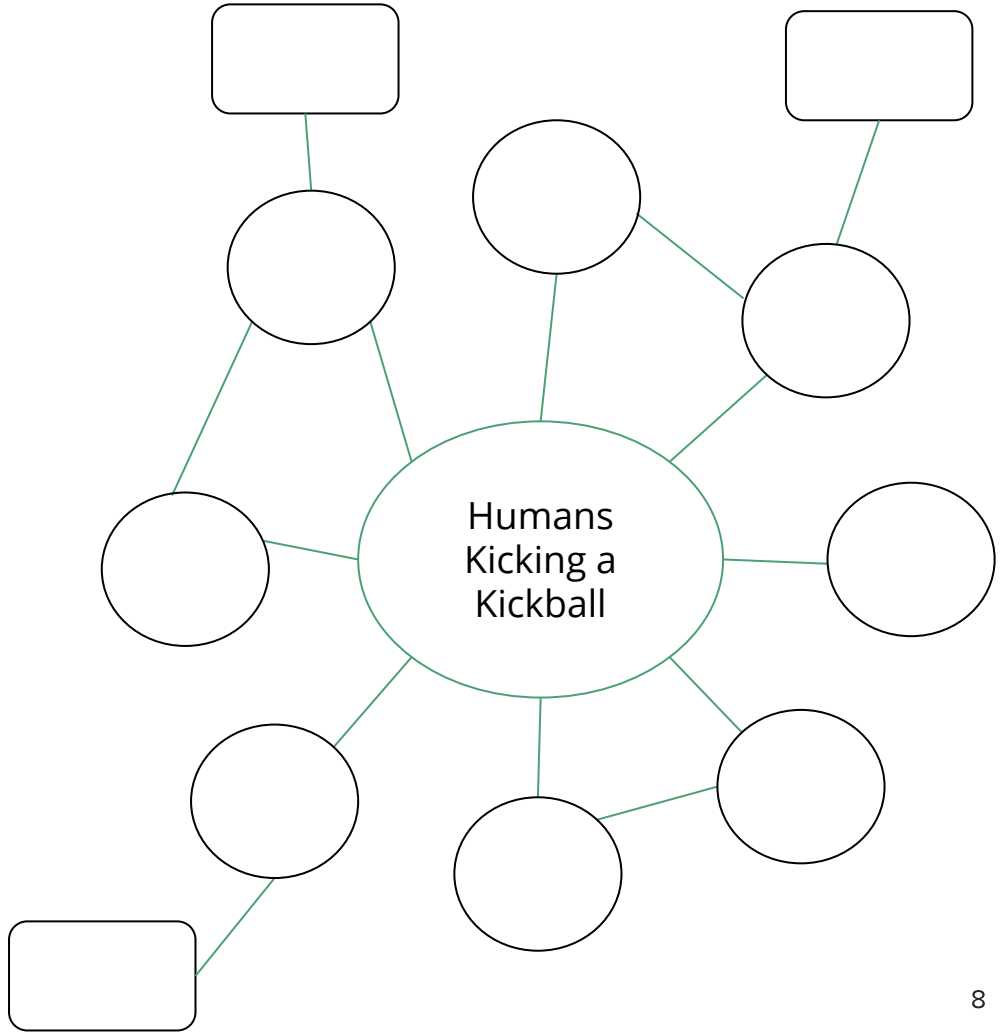
Generate Questions!

If you wanted to know more about what is happening when humans kick a kickball, what questions would you ask?

Group Concept Map

As a group, create a concept map that shows:

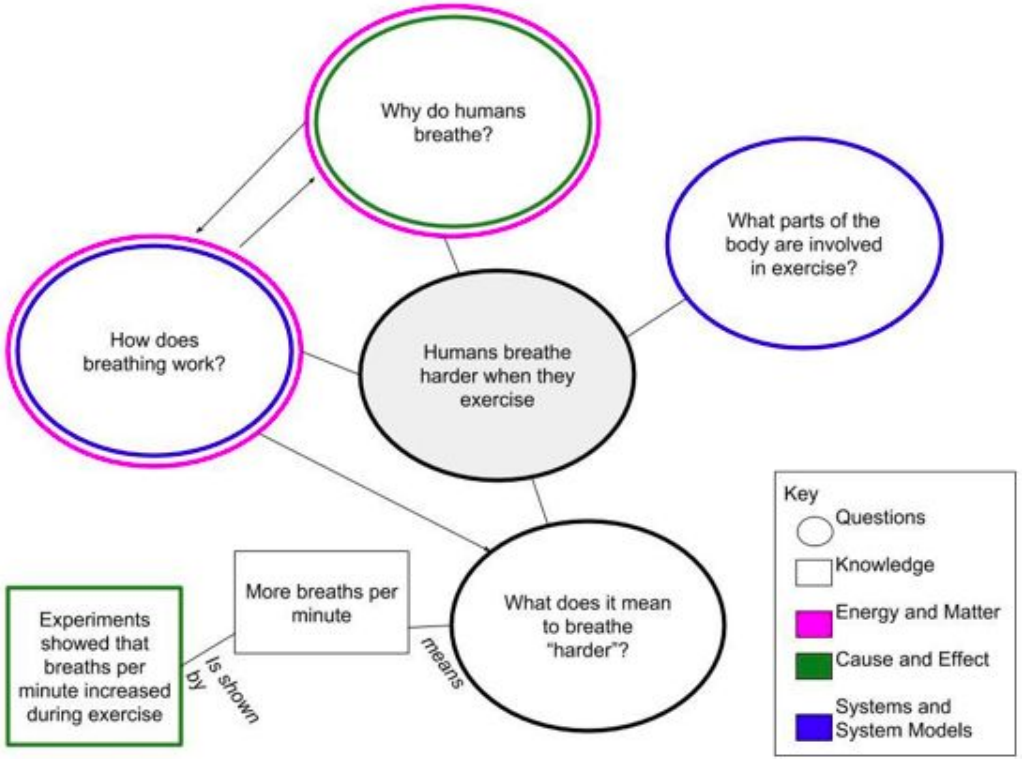
- Questions your group members had in common (circles)
- Possible answers to some questions (squares)
- Connections between related questions (lines)



Class Concept Map

As a class, create a concept map that shows:

- Key questions (circles)
- Possible answers to some questions (squares)
- Connections between related questions (lines)
- Crosscutting concepts used (trace in color)

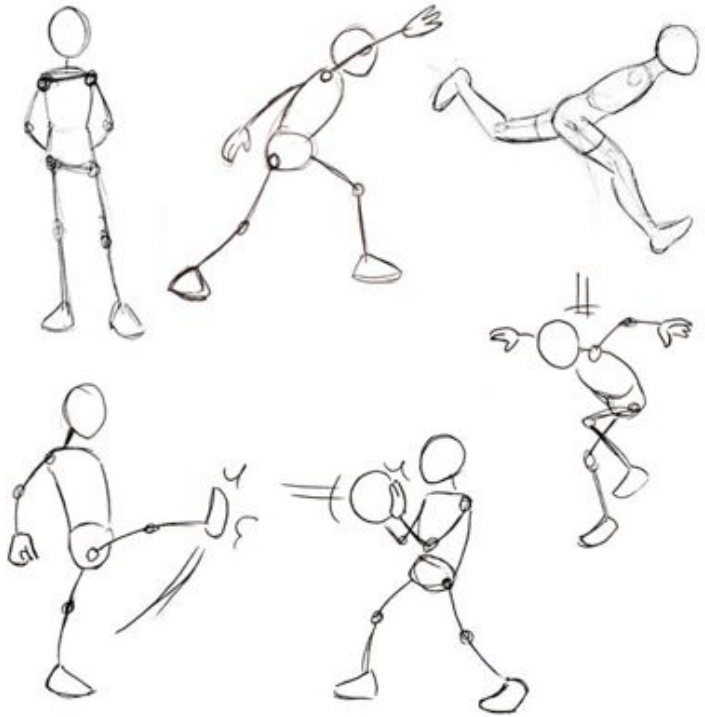


Introduction to the Culminating Project

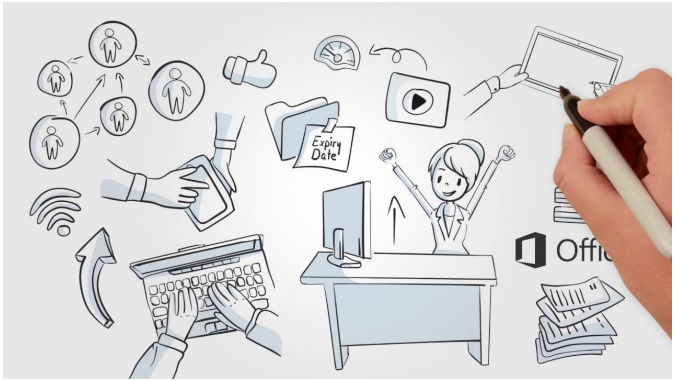
Teach people how their bodies make the movement of objects possible!

Group Project - Presentation that demonstrates and analyzes a physical activity

Individual Project - A brochure explaining all the science behind a physical activity



Presentation Format Options



Connecting to the Culminating Project

You have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Brainstorm a list of activities that involve humans putting an object in motion. Circle ones that you are interested in using for your project.

Complete this **individually** in your Project Organizer.

Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in the Lift-Off Task.

Energy in Motion

Task 1

What questions do you still have?

Engage

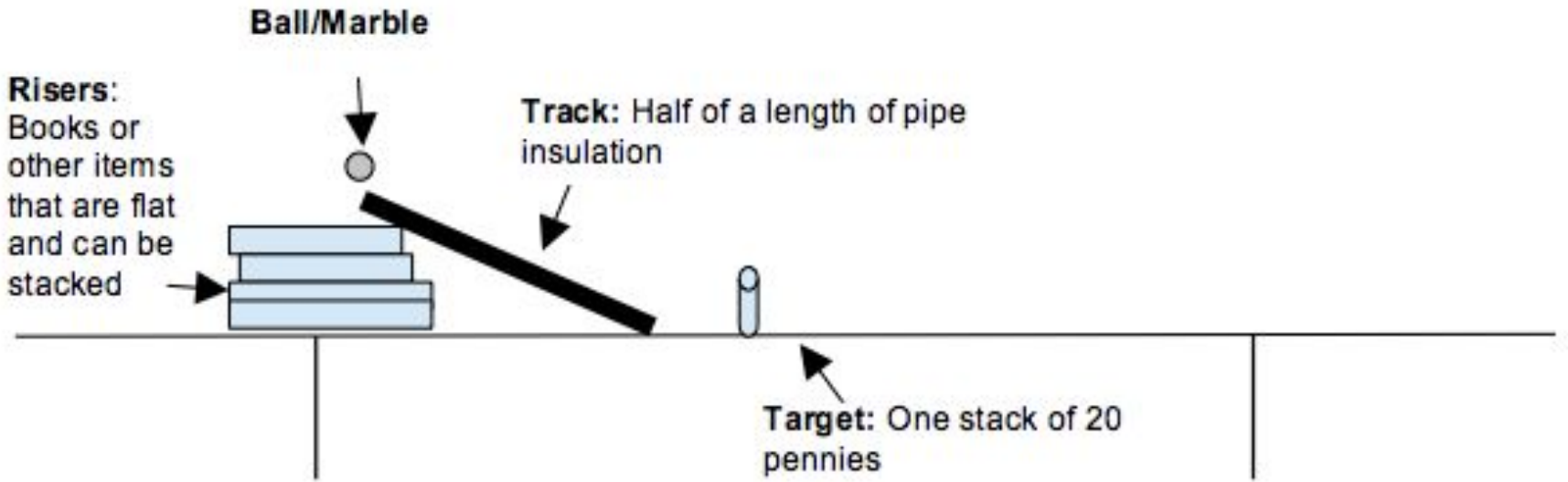
What is the science behind the motion of objects? Let’s investigate!

In pairs, follow the instructions in your student guide.

Rub your hands together at different speeds and make some observations and hypotheses.

Explore

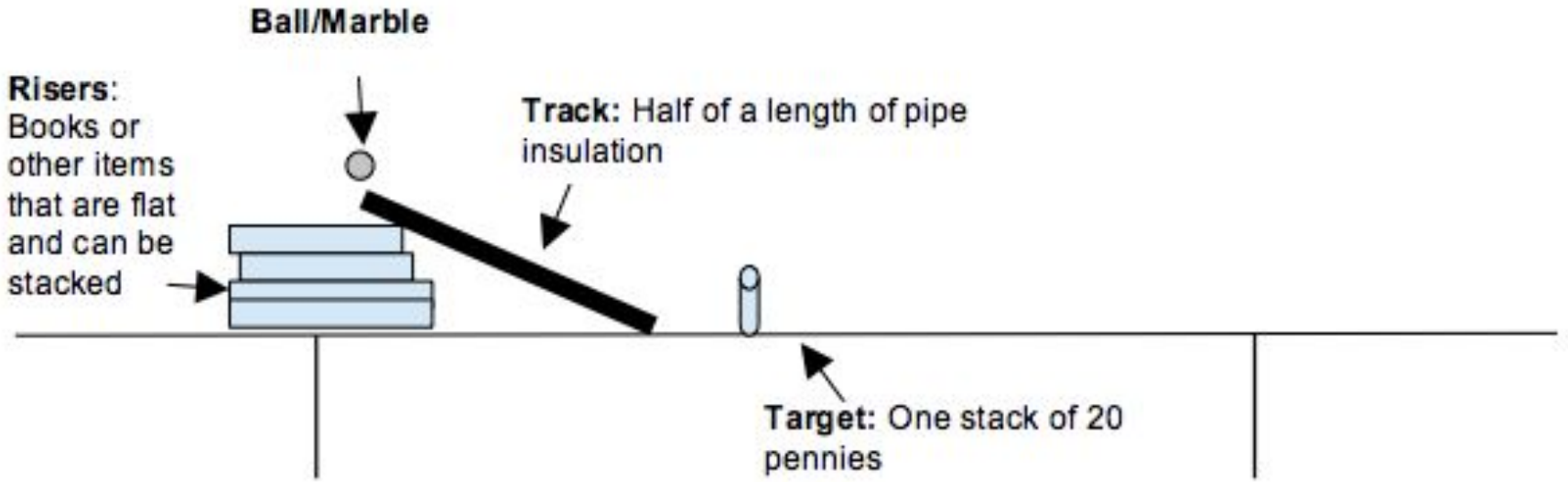
How does changing the position of a ball on a ramp affect the amount of stacked pennies it knocks over at the bottom of the ramp?



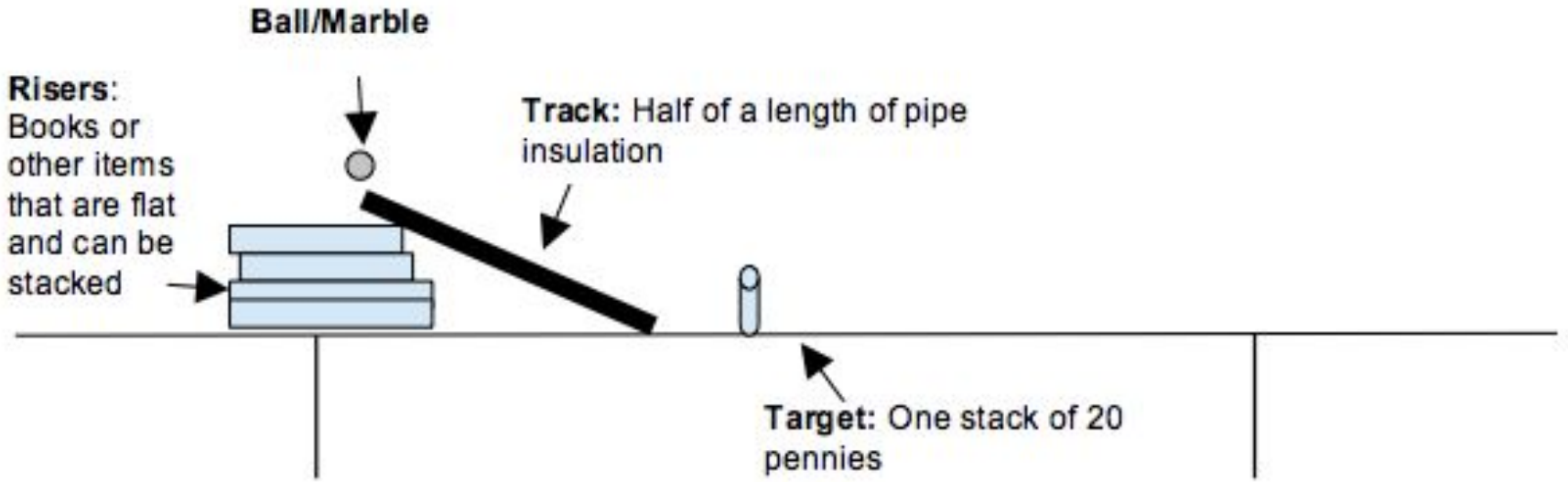
Make a Prediction

I think that the _____ (higher/lower) the ball is on the ramp, the _____ (more/less) stacked pennies it will knock over at the bottom of the ramp.

In groups, set up and run the experiment



Class Discussion: Why do you think there was a change in the number of pennies knocked over?



Explain

How can we explain what is happening in our investigations? Let's read about energy!

The scientific concept of **energy** can help us understand why objects behave the way they do. If a **force** is applied to an object, this can cause the energy of that object to change. For example, when you push a table, you are applying a force. This changes the energy of the table, making it move.

This energy that an object has because of its motion is called **kinetic energy**. Kinetic energy can be **transferred** between objects or **transformed** into other kinds of energy. You can tell when kinetic energy changes because there are key observable features, such as **motion**, **temperature**, or **sound**. For example, when a bowling ball collides with bowling pins, some of the ball's kinetic energy is transferred to the pins and some to the surrounding air. This transfer of kinetic energy increases the amount of kinetic energy in the pins and the air. This is what makes the pins move and creates the loud sound you hear!

Sometimes you can predict an object's kinetic energy. If you put an object at a higher position, it will have more kinetic energy when it begins moving. This is called **potential energy**—or the stored energy an object has because of its position. For example, when you pick up a heavy book off the ground and raise it into the air, you are applying a force that increases the energy stored in the book—its potential energy. When you drop the book and let it fall, the potential energy is converted into kinetic energy. Thus the more potential energy (higher position) in an object, the more kinetic energy it will have.

Engaging in Argument From Evidence

Construct an argument to explain the role of energy in both the *Engage* and *Explore* investigations. Support your argument with data from the investigations.

Terms to Use:

transfer, transform, kinetic energy, potential energy, motion/move, temperature

But first, let's do a Critique-Correct-Clarify

Prompt: Construct an argument to explain the role of energy in both the *Engage* and *Explore* investigations. Support your argument with data from the investigations.

Critique: Analyze Student A's claim below and identify the errors, things that aren't clear, or ways to add to the claim. Share with a partner.

> *Kinetic energy is the type of energy involved in both investigations.*

Correct: Write an improved claim in your student guide.

Clarify: Describe how and why you corrected the claim to a partner.

Elaborate

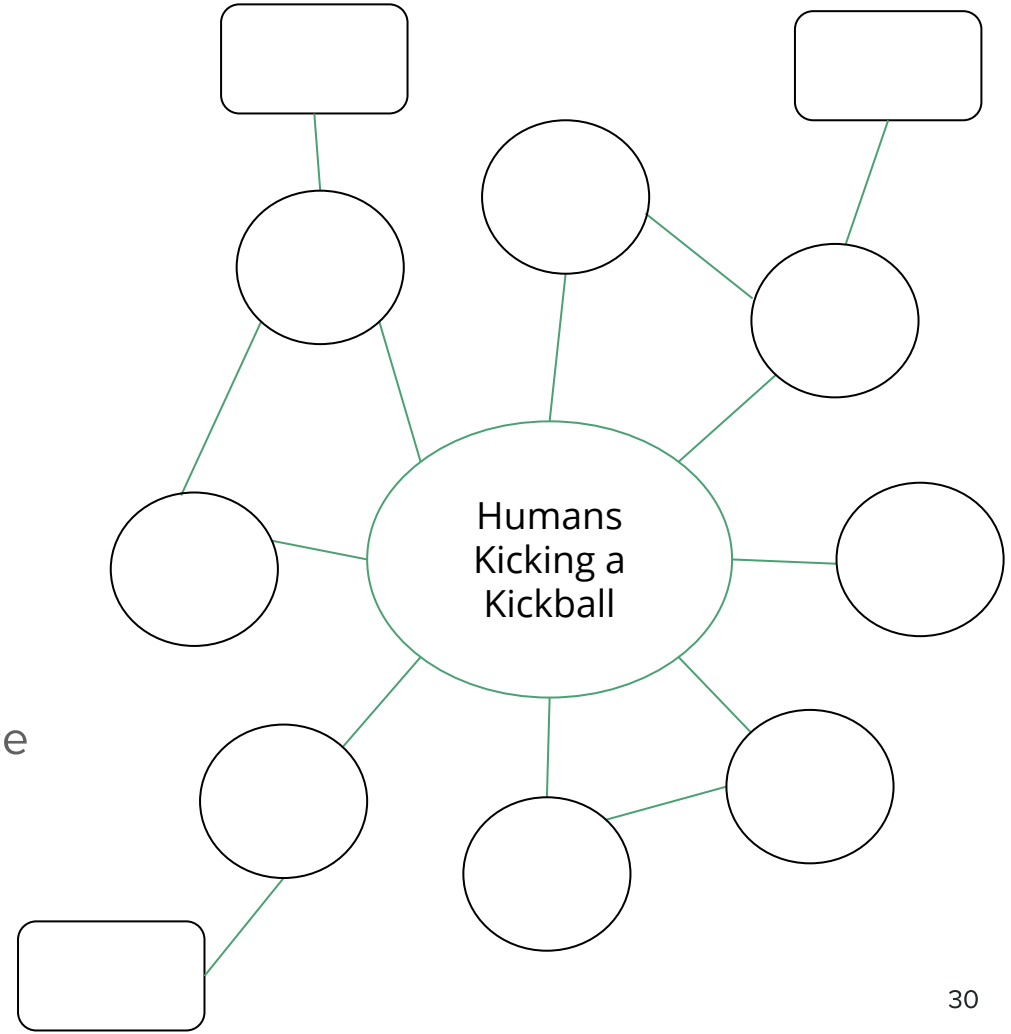
How can you explain this scenario?

A car’s wheel is spinning at a rapid speed while it is parked. The driver wants to know why there is so much smoke.

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
    - Energy and Matter



Evaluate

Connecting to the Culminating Project

You have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Your presentation will involve demonstrating an activity and explaining the science behind an object's motion. As a group, first decide on an activity that puts an object in motion to focus on for your culminating project. Then individually,

- Describe how an object moves in your group's chosen activity.
- Explain what you would need to change the motion of the object (e.g, make it go faster/slower or farther/closer). Describe how this changes the object's kinetic energy.
    - Cite evidence from your argument or investigations to support your explanation.

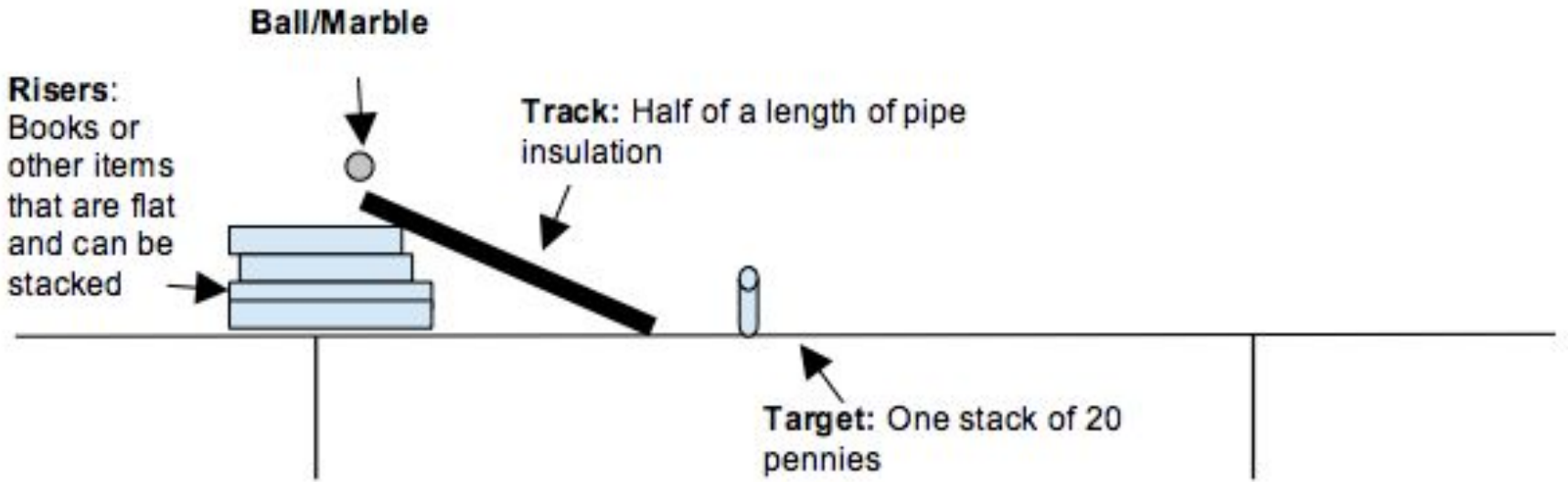
Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 1.

Sense and Respond

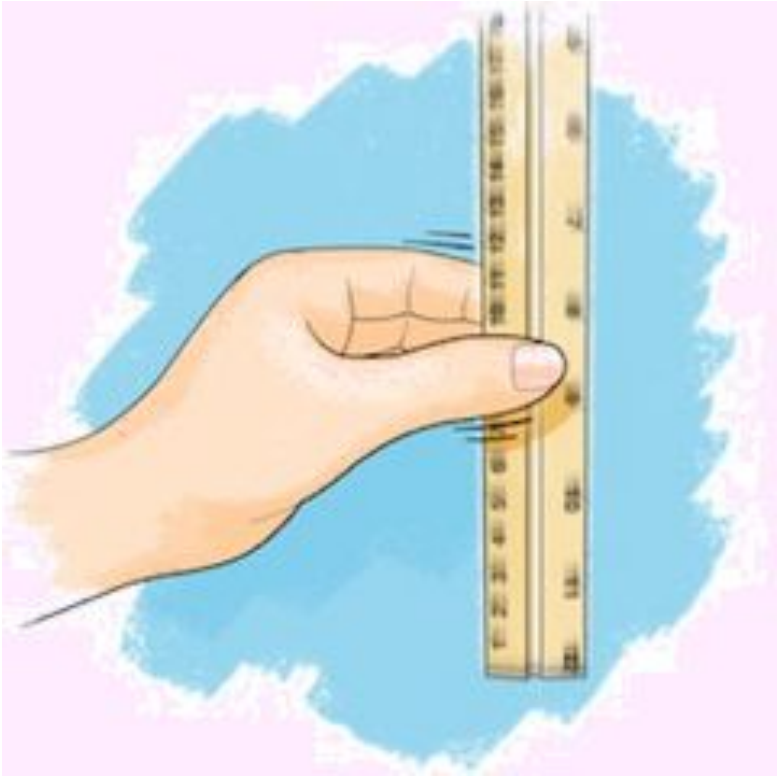
Task 2

What questions do you still have?



Engage

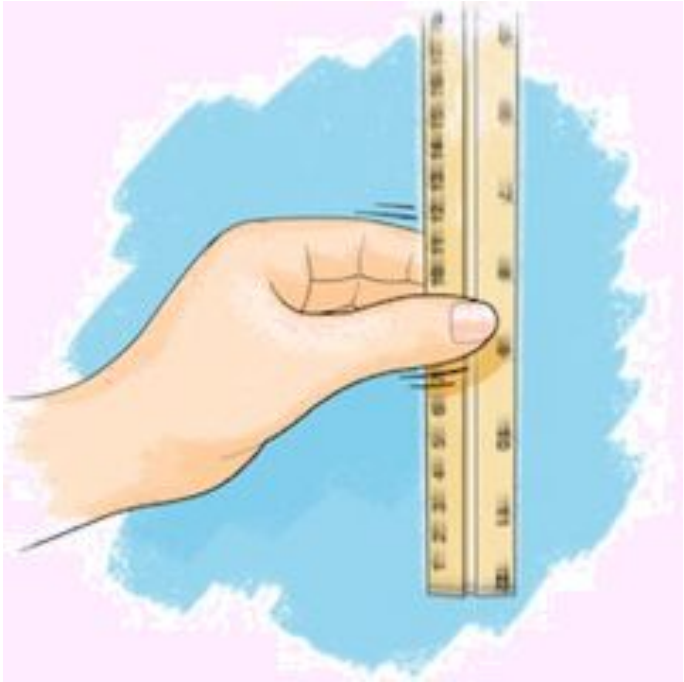
How Do Our Bodies Take Action?



“Catch the Ruler” Game

1. Goal: Catch the ruler with less than 7 cm left at the bottom!
2. With a partner, follow the instructions in your Student Guides to play the game.
3. Debrief the questions that follow to analyze what happened in the game.

Class Debrief: What process do you think your body goes through to be able to catch a ruler?



Explore

Obtaining, Evaluating, and Communicating Information on The Nervous System

With your group,

1. Use the resources provided to learn more about the nervous system.
2. Take notes in the table in your Student Guide.

Nervous System Definition Cards

Stimulus

Something that creates a response in the body (can be seen, heard, smelt, felt, or tasted).

Response

A behavior (e.g., action, thought, or stored memory) that results from a stimulus.

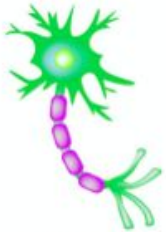
Spinal Cord

An organ that carries messages from the sensory neurons to the brain and from the brain to the motor neurons.

Sensory Neuron

A cell in the nervous system attached to a sense organ (e.g. eye), which receives messages from the body's outside environment and passes it towards the brain or spinal cord.

Motor Neuron



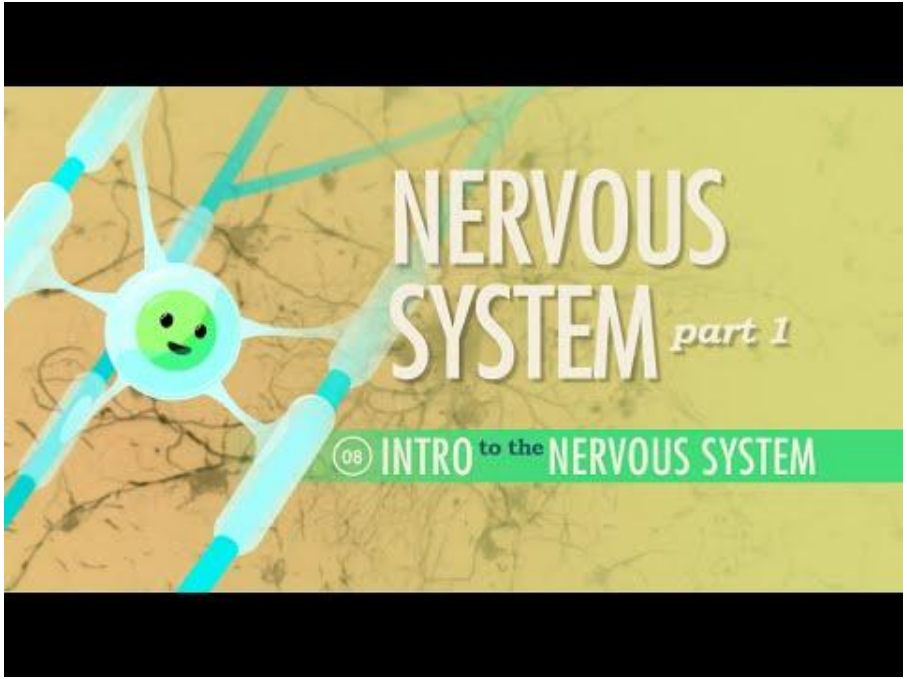
A cell in the nervous system attached to an effector cell (e.g. muscle), which receives messages from the spinal cord and triggers a response.

Brain

An organ that processes incoming messages, resulting in the storage of memories or the sending out of messages to motor neurons to produce actions.

Label With New Terms and Definitions

Nervous System Video



https://www.youtube.com/watch?v=qPix_X-9t7E (0:00 - 3:30 and 8:35 - 9:25)

Nervous System Relay Race

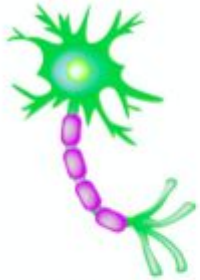
Imagine a person is participating in a relay race: they must feel the tap of their teammate's hand before they can begin running.

With your group, discuss how this message would move through your nervous system.

Nervous System Relay Race Roles

Sensory Neuron

Motor Neuron



Spinal Cord

Brain

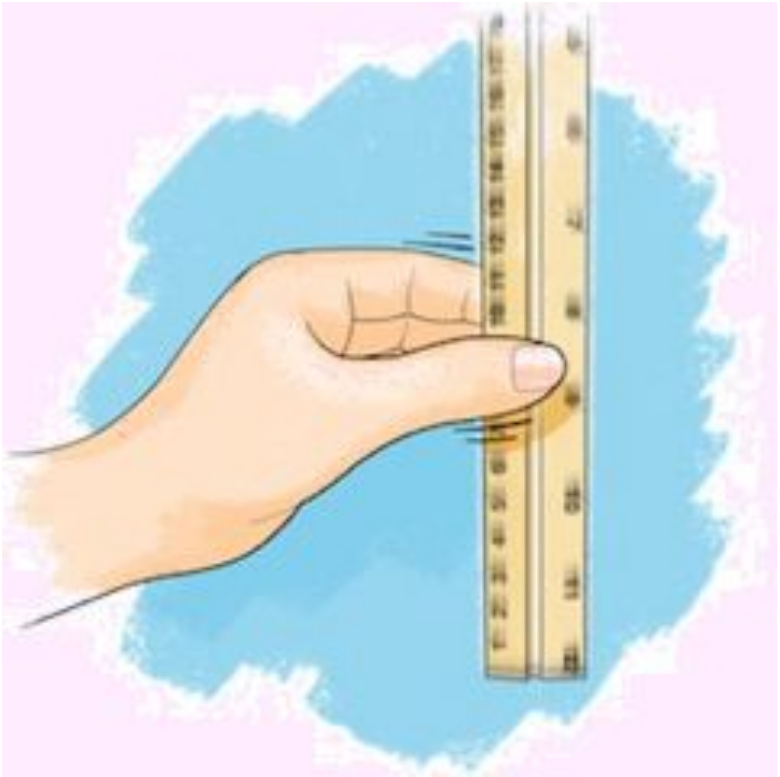
Your teacher will act as the **Stimulus** by tapping on the hand of the student who represents the first part of the nervous system response.

Raise your hand when you think your group is ready for the **Stimulus**!

Class Debrief: What did your nervous system pathway look like?

Explain

Remember the “Catch the Ruler” Game?



How did your nervous system allow you to catch the ruler?

Individually,

1. Draw a flowchart of the nervous system pathway using words, images, and arrows.
2. Why do you think no one was able to catch the ruler quickly enough to have less than 7 cm left at the bottom?

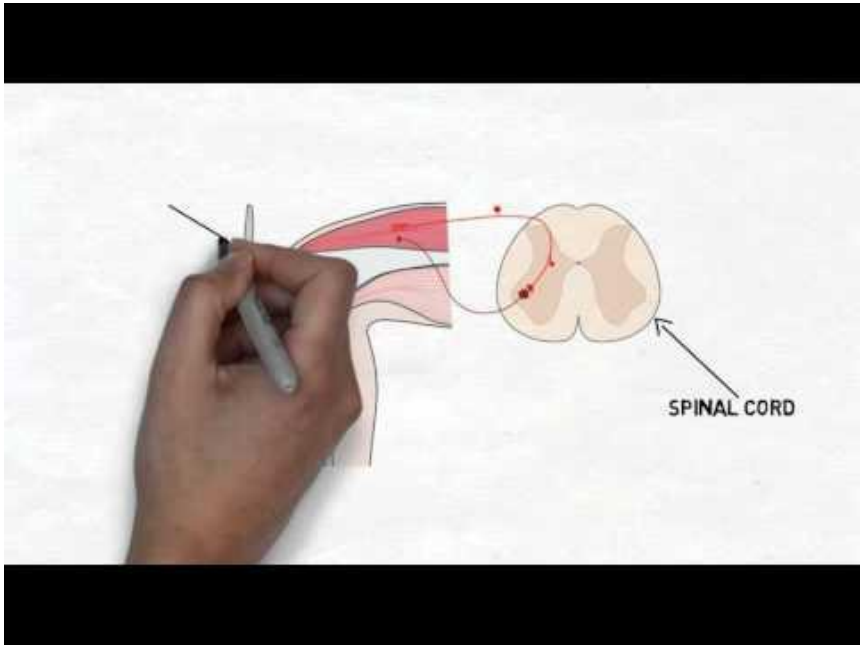
Elaborate

What about when there isn’t a conscious decision to act, but your body acts anyways?

With a partner,

1. Follow the procedure in your Student Guide to try the knee-jerk response.
2. Answer the questions to help you analyze what happened.

Review: What is a Reflex Arc?



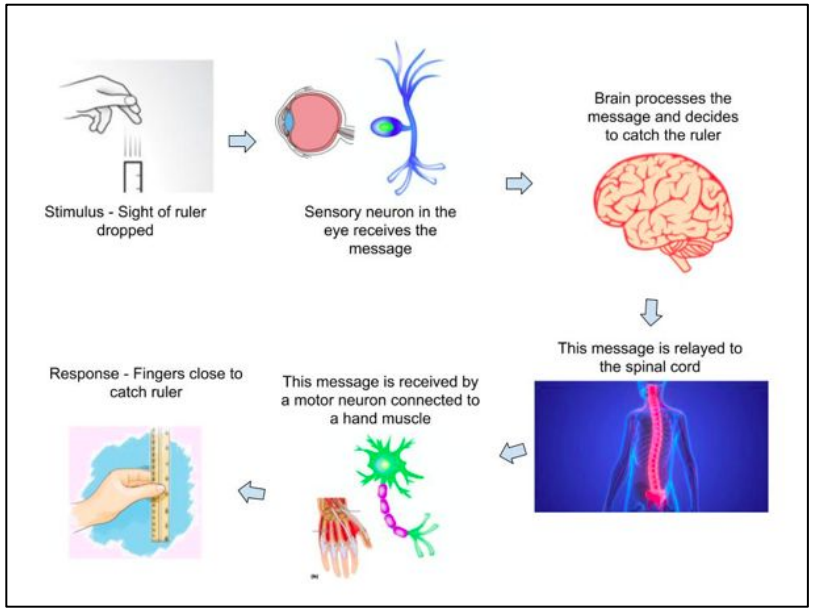
https://www.youtube.com/watch?v=c-dD0N53QRg
(Stop at 1:10)

How can you explain the knee-jerk response?

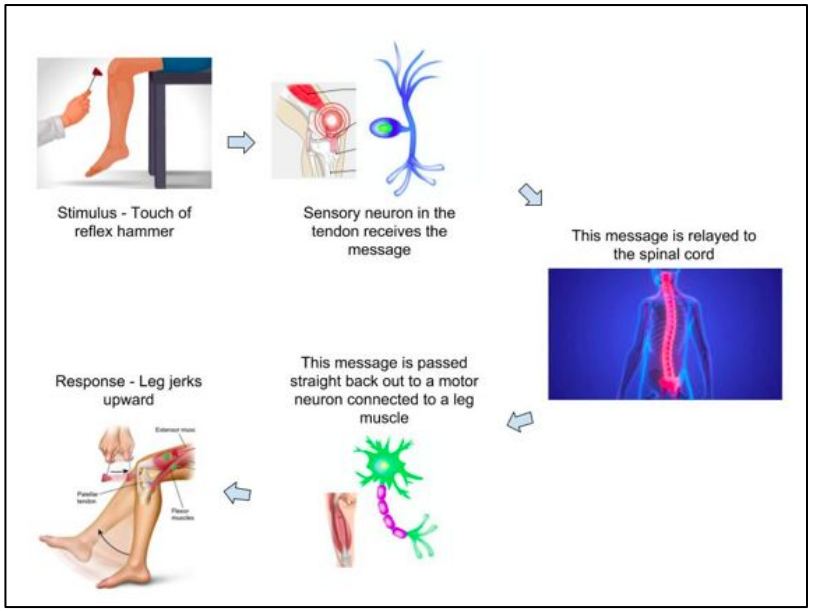
Class Flowchart of Knee-Jerk Reflex

Why do you think our bodies have developed a reflex response to certain stimuli?

Compare: What is different between these two?



"Catch the Ruler" Game

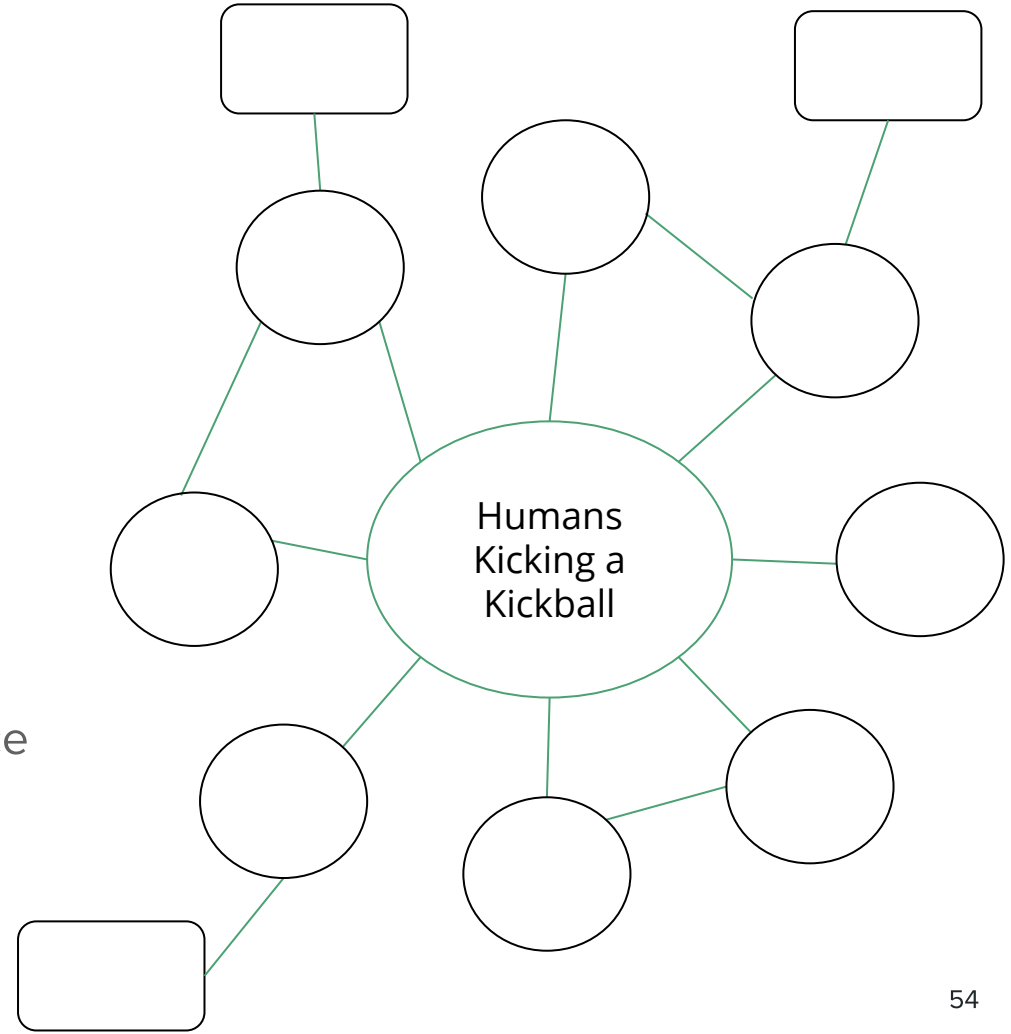


Knee-Jerk Reflex

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
    - Cause and Effect



Evaluate

Connecting to the Culminating Project

You have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Your presentation and brochure will include showing how the body's nervous system allows it to move objects in your chosen activity.

- ➢ Describe the nervous system pathway involved in your chosen activity. You may draw a flowchart, like you did in this task, or describe the pathway in a numbered list or paragraph.

Complete this **individually** in your Project Organizer.

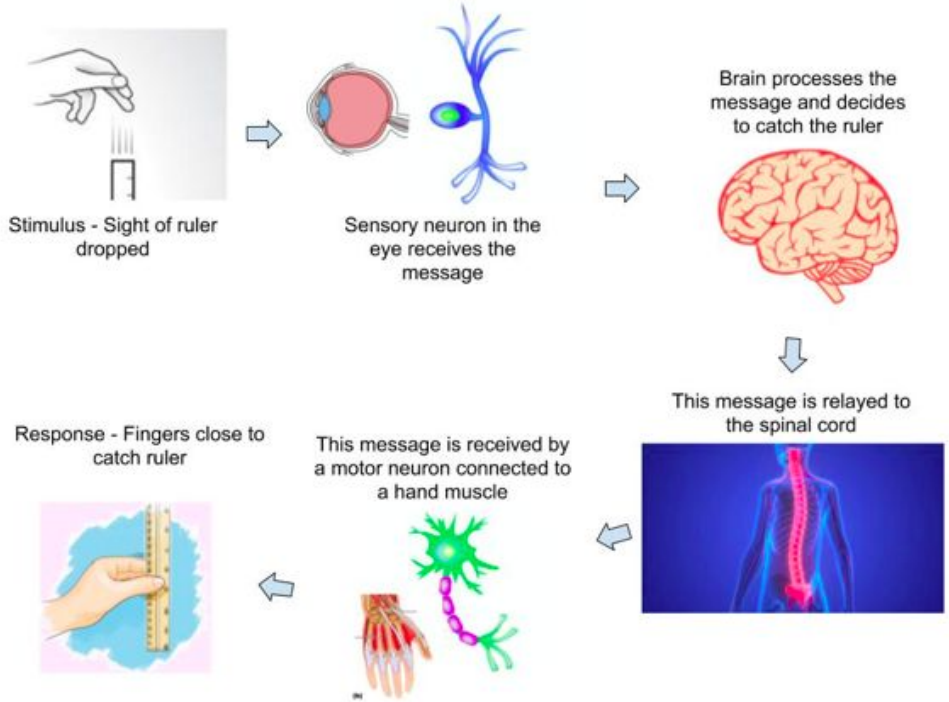
Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 2.

Interacting Subsystems

Task 3

What questions do you still have?

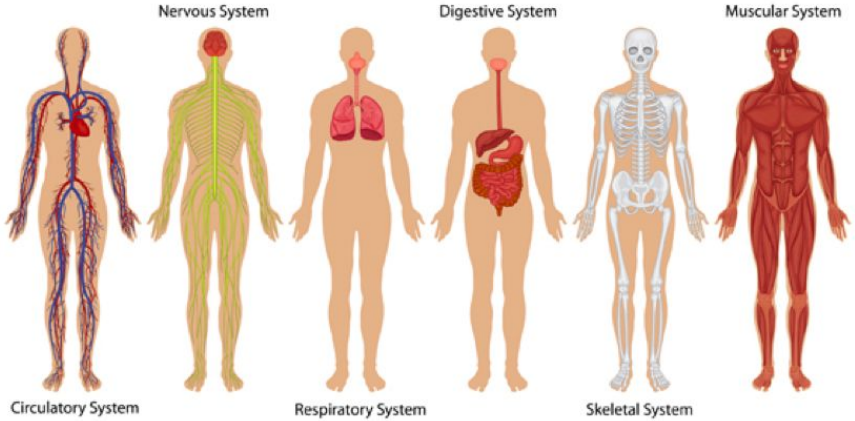


Engage

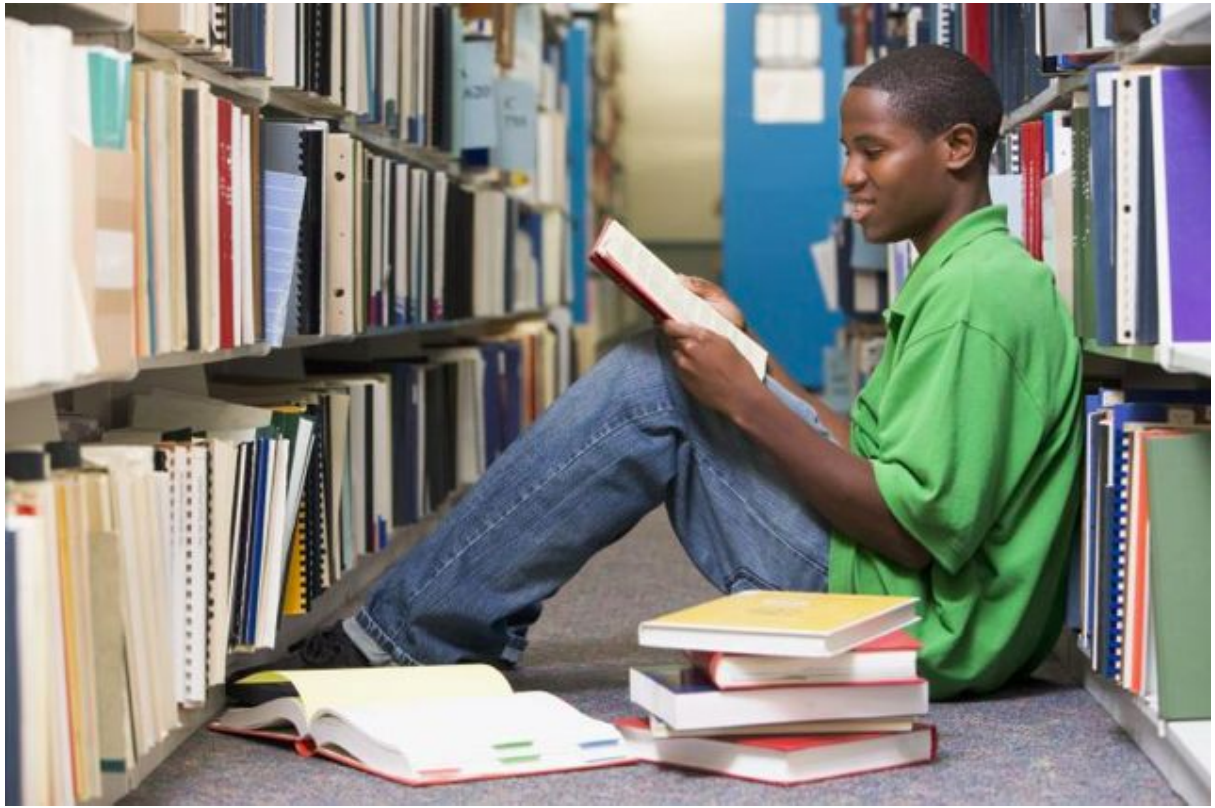
What other body subsystems are used when you do different activities?

For each picture of a real-life activity:

1. Discuss with your group which body systems are involved. Record on a blank piece of paper.
2. Show your paper at the same time as other groups.
3. Compare and discuss differences as a class.



Reading

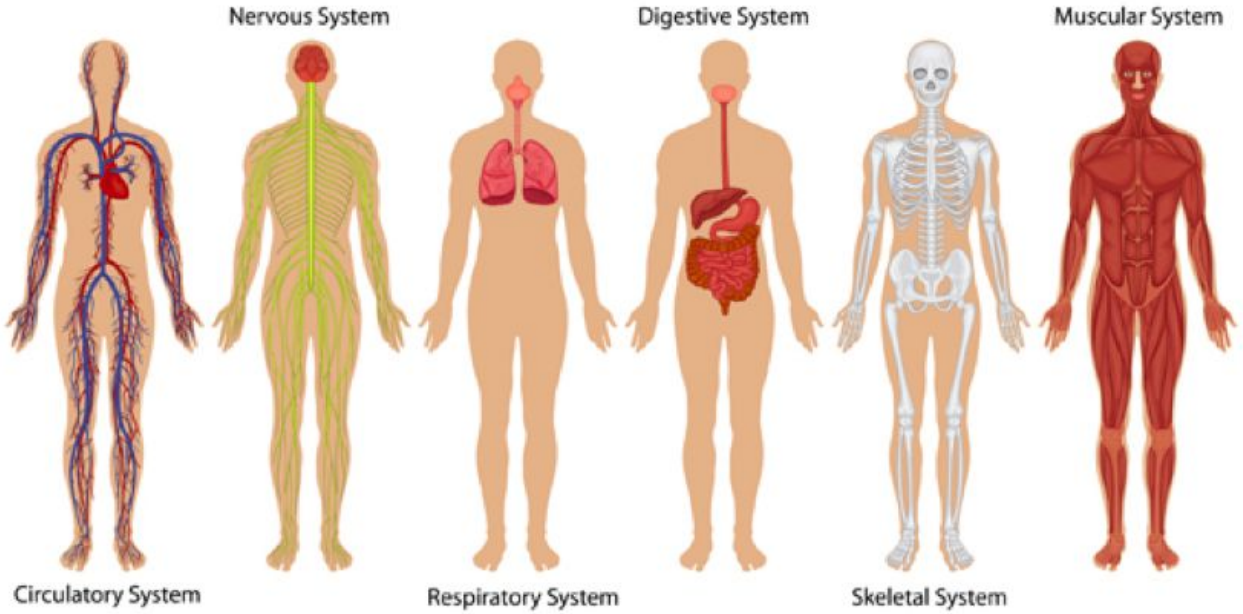


Running

Sleeping

Swimming

Class Debrief

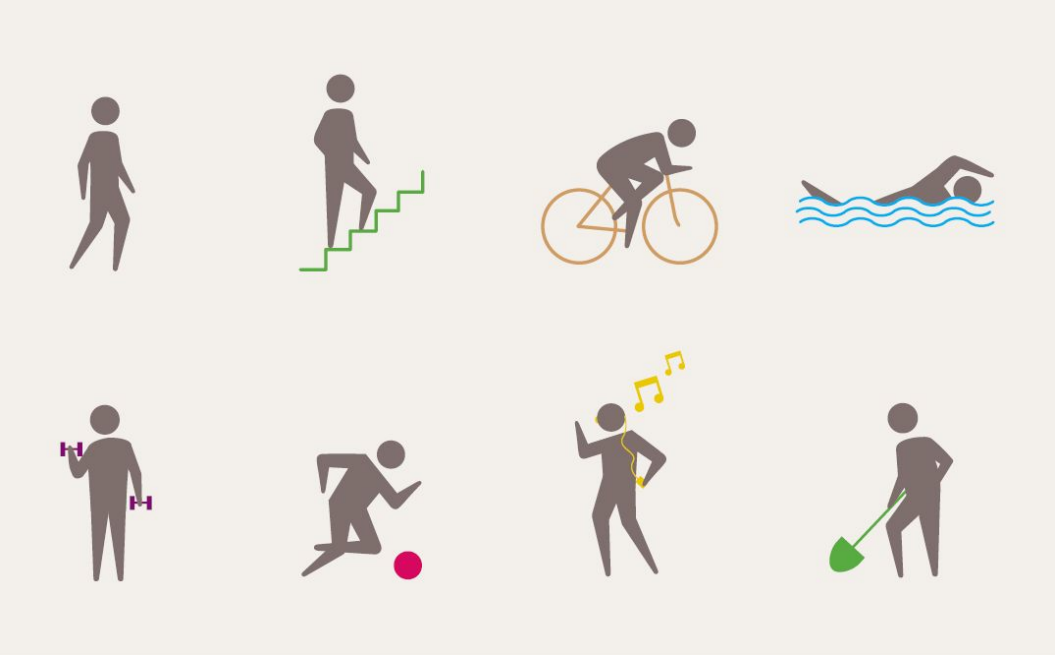


Which body systems did the class think were involved in *most* of the activities?

Which body systems did the class think were involved in only a *few* of the activities?

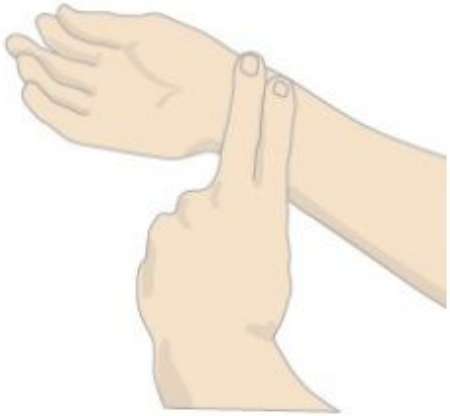
Explore

Exercise Investigation

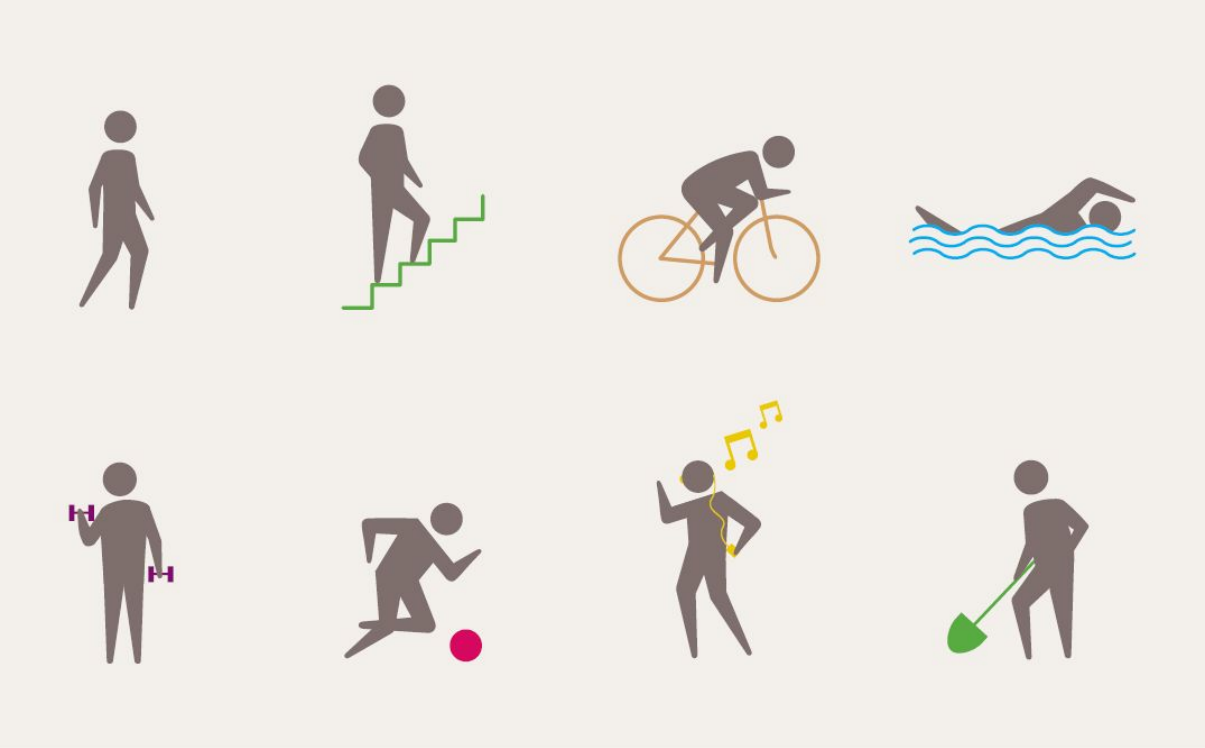


With your group, follow the procedure in your Student Guide to conduct an exercise investigation.

You Will Be Measuring Heart Rate, so Let’s Practice!



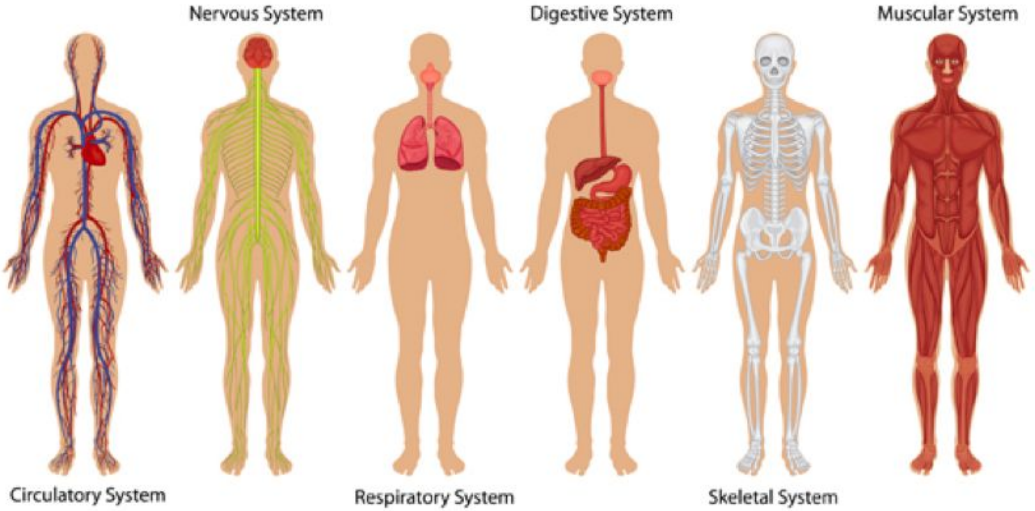
Class Debrief: What trends did you notice?



Explain

Engaging in Argument From Evidence

A student from another class is arguing that doing exercise requires only the respiratory and circulatory system to work together.



Individually, write an argument supporting or refuting this student's claim.

Use the *Subsystems of the Body* article for additional information in your argument

SCALE

Unit 1, Task 3

Article - Subsystems of the Body

Explain

All the subsystems of your body must work together so your body can function. In the table below, we describe six main body subsystems:

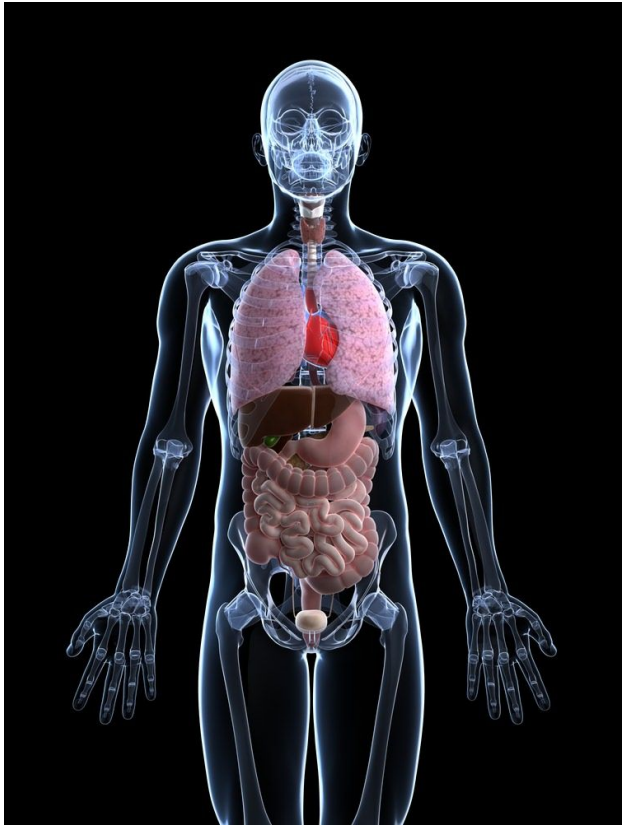
Subsystem	Major Parts	Description
Nervous 	• Nerves • Brain • Spinal Cord	The nervous system senses stimuli from the environment, processes information, stores memories, and controls the body's actions. It interacts with all other subsystems to receive information and create the necessary reactions.
Circulatory 	• Red Blood Cells • Heart • Blood Vessels	The circulatory system carries important molecules throughout the body. Blood travels to all cells throughout the body to deliver nutrients (from the digestive system) and oxygen (from the respiratory system), which they need to make energy. Blood also carries away waste products from cells, like carbon dioxide, so systems like the respiratory system can get rid of them.
Respiratory 	• Lungs • Trachea	The respiratory system takes in (breathes in) oxygen and releases (breathes out) carbon dioxide. It works closely with the circulatory system because the blood comes to the lungs to pick up oxygen for cells and drop off carbon dioxide that was made by cells. The nervous system also checks in on the body's physical activity and can adjust the rate of breathing by communicating with the lungs.
Digestive 	• Mouth • Esophagus • Stomach • Intestines	The digestive system makes the energy in food available to cells in the body by breaking it down into smaller pieces, called nutrients. Muscles control the movements of the digestive system and the nervous system tells it when to be active and when to rest. The circulatory system brings the digestive system the oxygen it needs and also picks up the nutrients that the digestive system harvested to delivers to other cells.
Muscular 	Muscle types: • Voluntary • Involuntary • Cardiac	The muscular system moves the body's parts, both external (like arms and legs) and internal (like the stomach and heart). Muscles control the movements of the digestive system and allow the heart to pump blood throughout the body. In order to function, muscles receive messages from the nervous system, which tells them what to do. They also need oxygen and nutrients to be delivered from the circulatory system so they have the energy to do their work.
Skeletal 	• Bones • Cartilage	The skeletal system supports the body, facilitates movement, and protects the body's internal organs. It works closely with the muscular system so the body is able to produce movement. Like all cells, it also needs nutrients and oxygen delivered from the circulatory system.

Elaborate

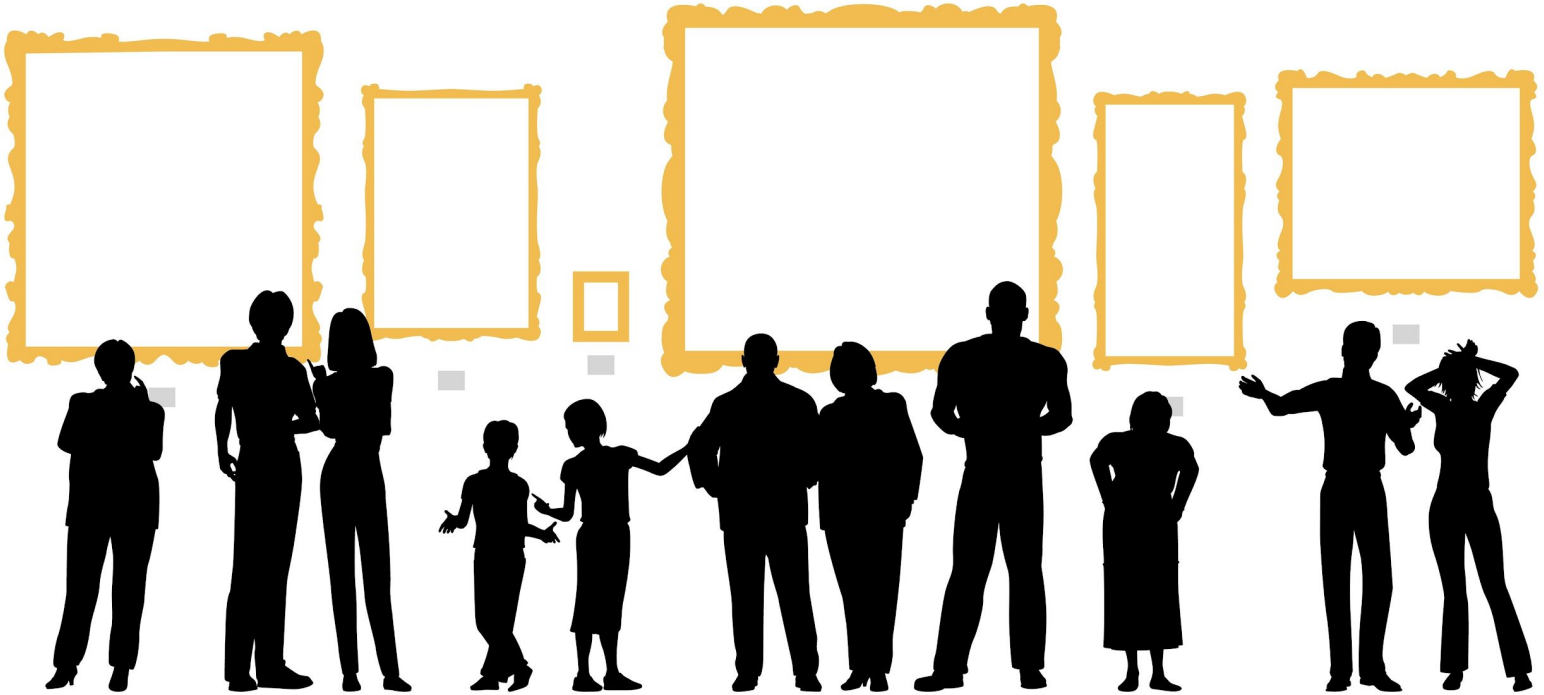
Make a Poster Model to Show Subsystems Interacting

Your poster should show a diagram or flowchart that includes:

- A labeled image of each subsystem that is used during exercise
- Key organs and tissues of each subsystem that is used during exercise (do some research!)
- Arrows and captions between the subsystems to describe how they interact



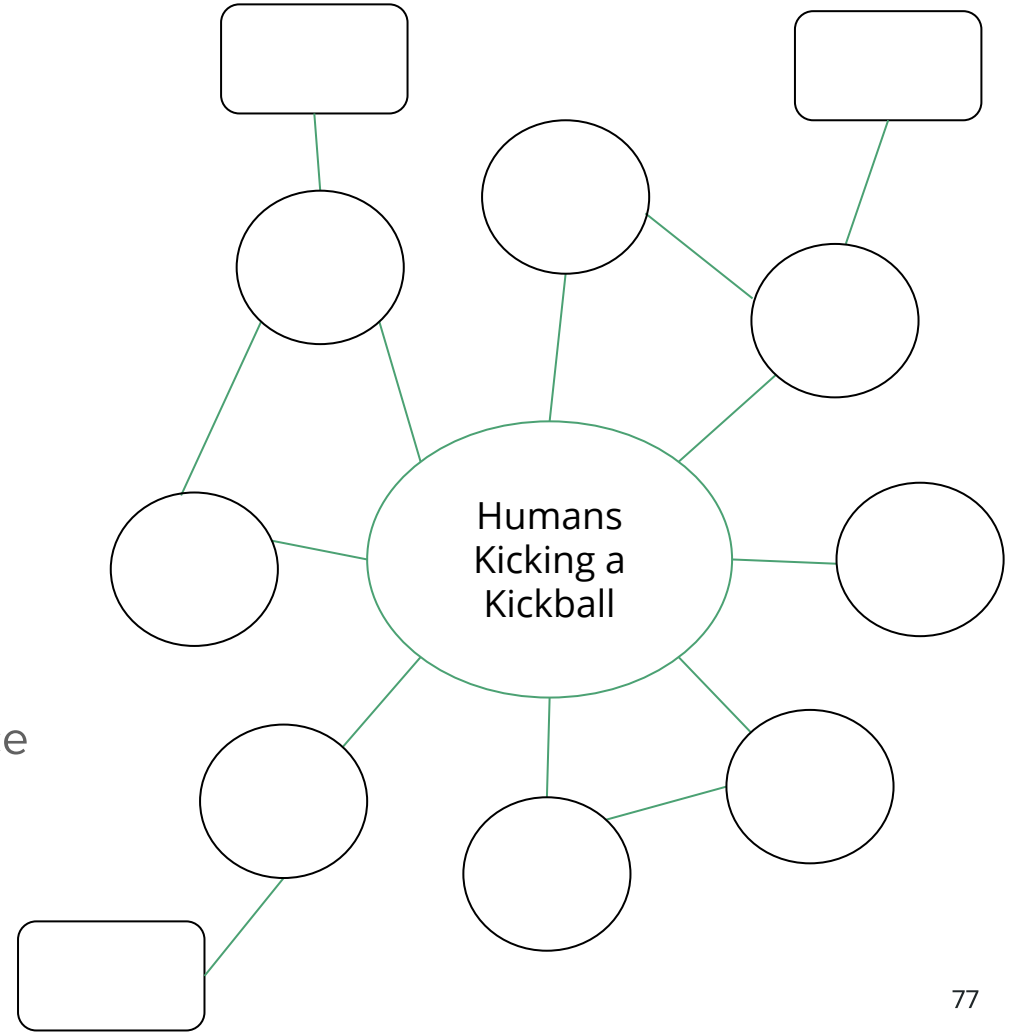
Gallery Walk



Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
    - Systems and System Models



Evaluate

Connecting to the Culminating Project

You have been asked to teach people how their bodies make the movement of objects possible in a specific activity. In this task, you learned that there are other subsystems of the body at work, besides just the nervous system.

➢ In a paragraph, flowchart, or diagram, explain how different subsystems of the body work together to do your chosen activity

Complete this **individually** in your Project Organizer.

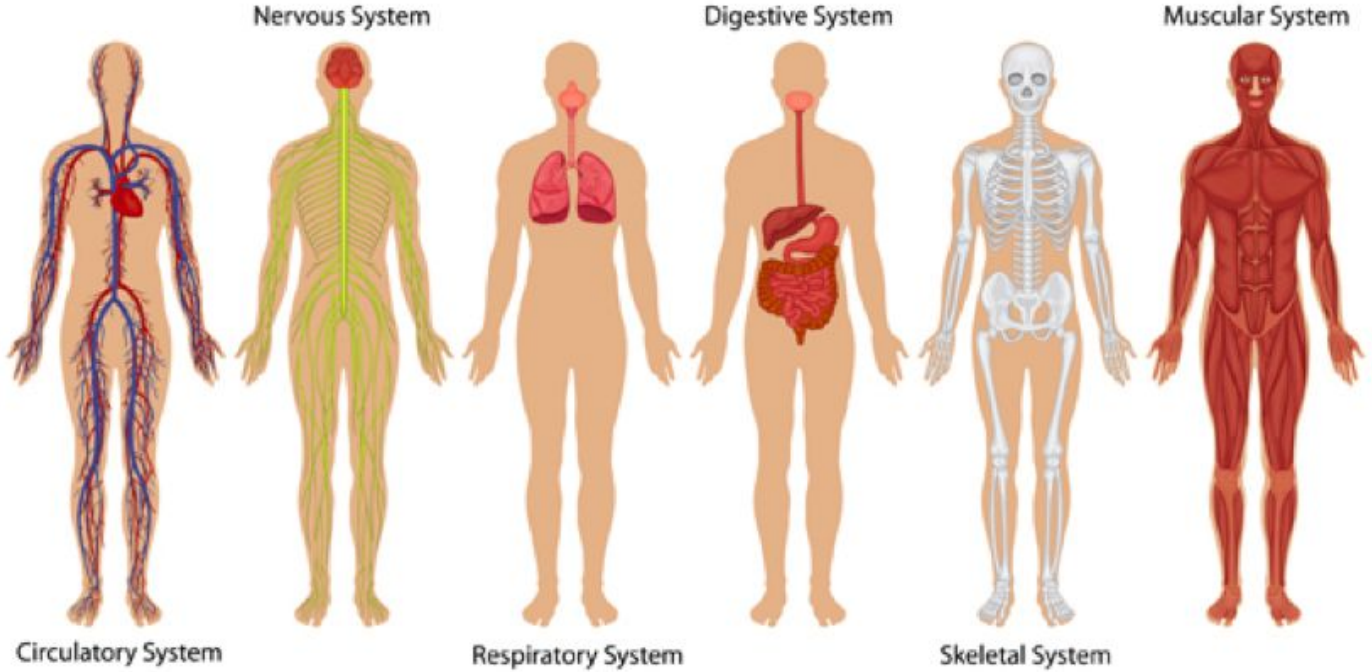
Reflection

Complete the questions at the end of your student guide to reflect on what you have learned in Task 3.

Got Cells?

Task 4

What questions do you still have?

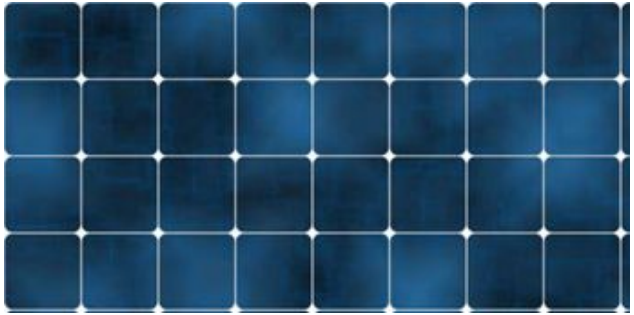


Engage

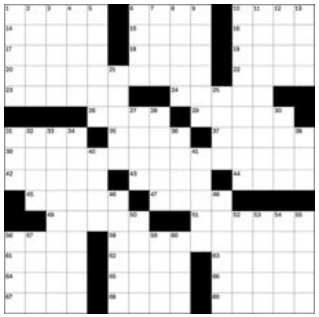
What is a Cell?

Non-Scientific Examples of Cells

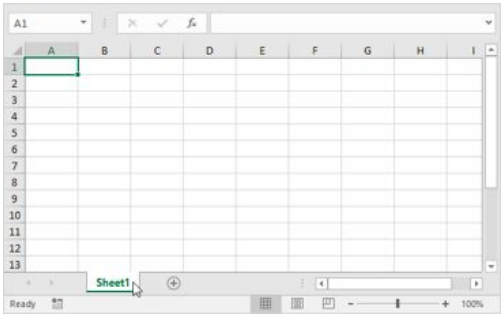
Solar Panel **Cells**



Crossword Puzzle **Cells**



Cells in an Excel Spreadsheet

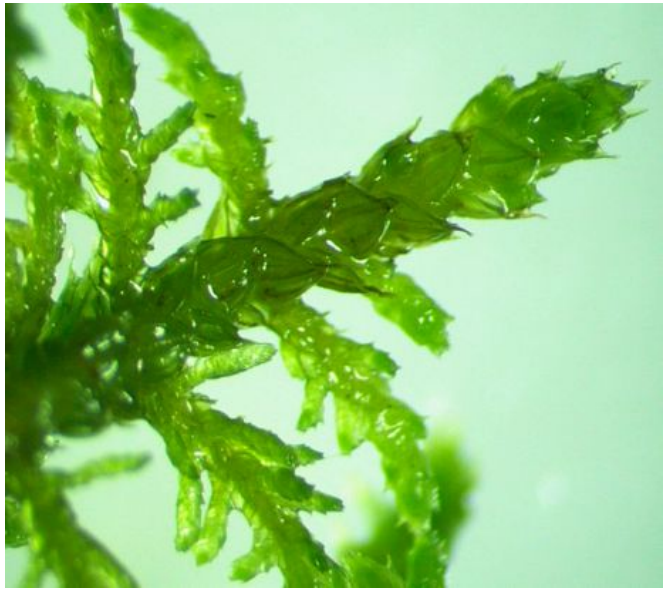


Open **Cells** in Foam Insulation

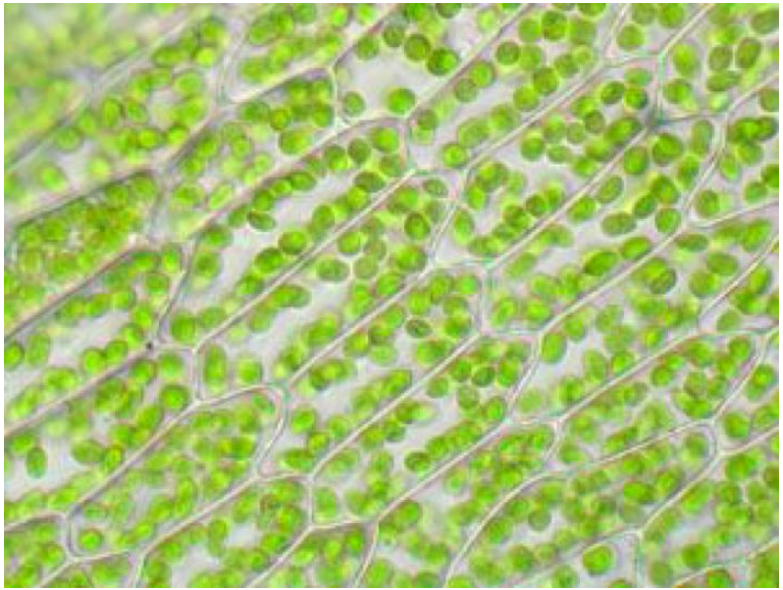
Construct a Class Definition of “Cell”

Explore

Scale, Proportion, and Quantity



Macroscopic
(Seen with the naked eye)



Microscopic
(Seen under a microscope)

Planning and Carrying Out Investigations

With your group, visit the lab stations to analyze both macroscopic and microscopic images of various specimens and record your observations in the chart below.

Which specimens are made up of cells?

Explain

Compare and Contrast the Various Specimens

Grouping 1	**Grouping 2**
Which images were similar?	Which images were different from the majority?
Describe what these images have in common.	Describe how these images were different from the majority of other images.

Class Debrief

What do you know about the specimens in Grouping 1 vs. Grouping 2?

Based on this knowledge and what you observed through the microscope, what types of specimens are made up of cells?

Elaborate

Critique-Correct-Clarify

Prompt: Are beehives living things? How do you know?

Critique: Beehives are living things because I can see with my naked eye that they are made up of wax cells.

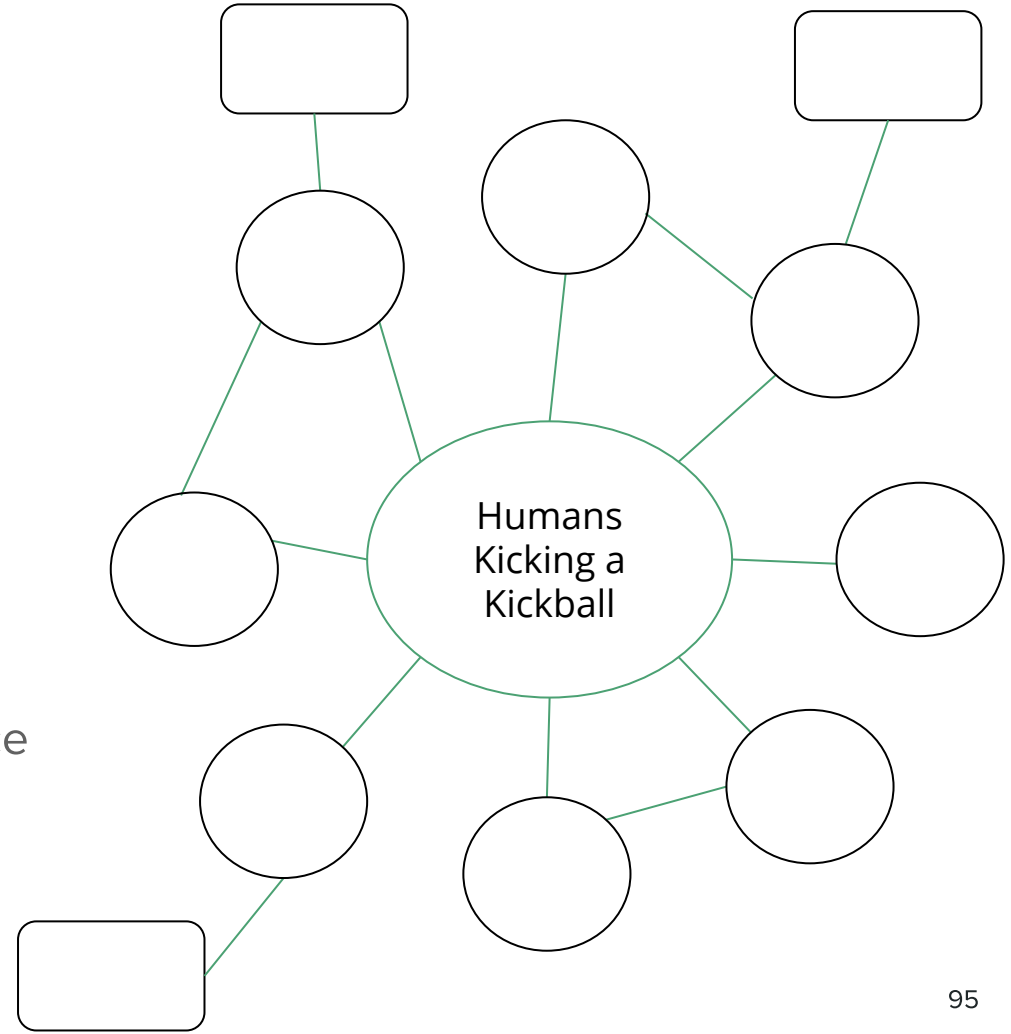
Clarify: Write an improved statement.

Correct: Discuss how you corrected the statement with a partner.

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
    - Scale, Proportion, and Quantity



Evaluate

Connecting to the Culminating Project

You have been asked to teach people how their bodies make the movement of objects possible in a specific activity. In the last task, you described the different subsystems of the body that are involved in your activity.

- ➢ Research and identify the types of cells that make up the body systems you identified.
- ➢ Why do you think these different types of cells look so different?
- ➢ Even though they appear different, why are they all called cells?

Complete this **individually** in your Project Organizer.

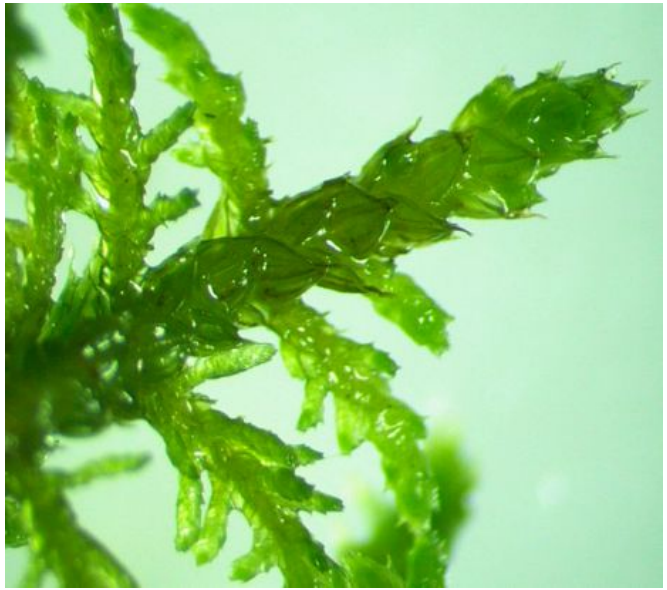
Reflection

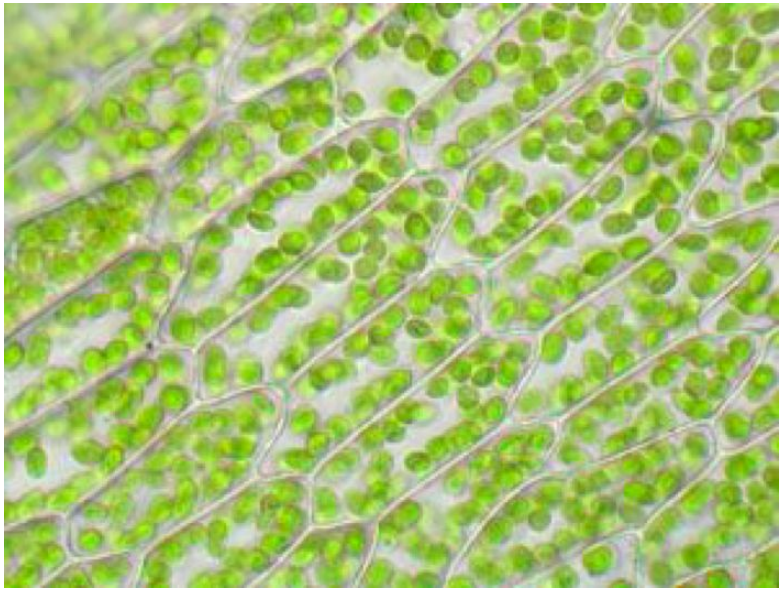
Complete the questions at the end of your student guide to reflect on what you have learned in Task 4.

Parts of a Whole

Task 5

What questions do you still have?

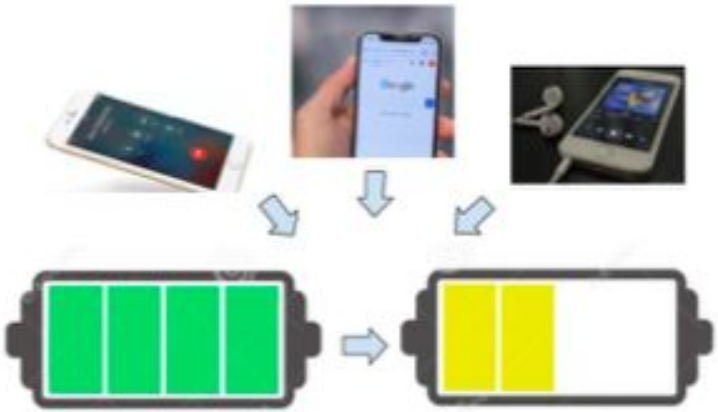




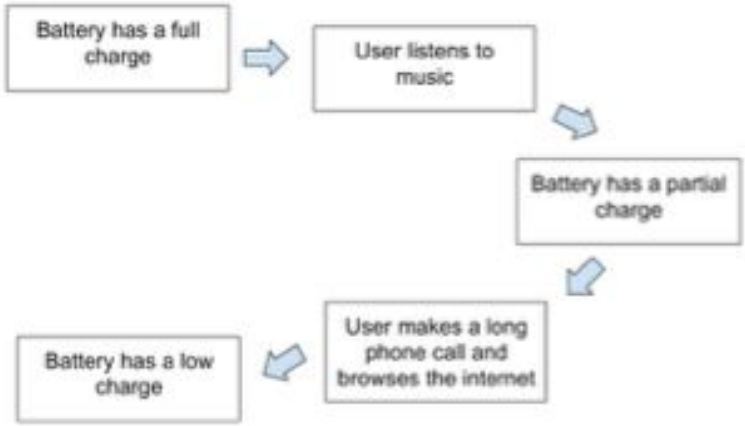
Engage

What is a Model?

Labeled Diagram:



Flowchart or Mind Map:



Analogy:

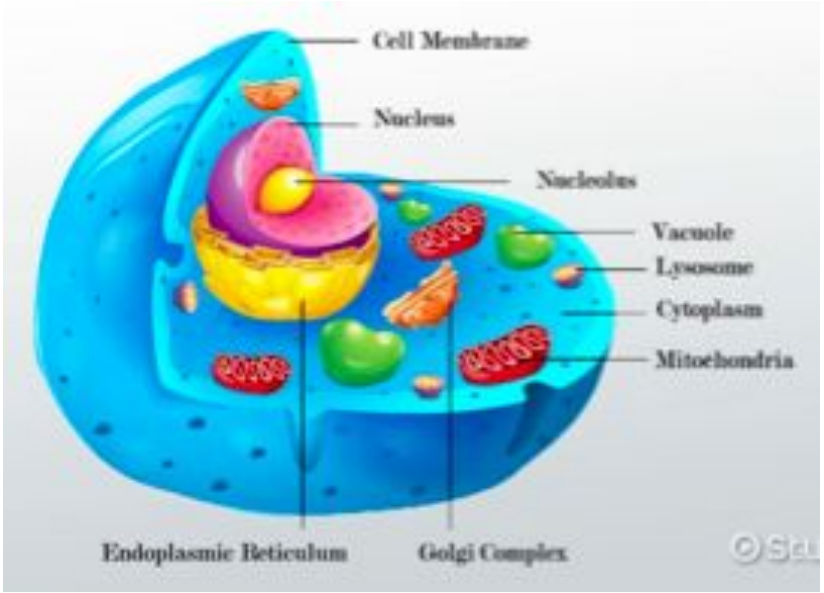
A draining smartphone battery is like a water jug that is slowly used throughout the day. Similar to the way a smartphone battery shows how much power is left, there are indicators on the jug to show how much water remains. Also, the power in a cell phone battery is used for different functions (internet, phone calls, music, etc.), just like the water in the jug is used for different functions (drinking, washing, etc.)

Discuss With a Partner

1. Based on the models shown, what do you think is the purpose of a model?
2. How are these three types of models different?
3. For this particular example, which type of model do you think is most helpful? Why?

Explore

Using Models - Analogy For a Cell



In groups,

1. Cut out your *Cell Definition Cards*.
2. Read the analogy aloud.
3. Draw a picture of the factory, including all its parts.
4. Discuss which cell part or substance matches each part of the analogy.
5. Record your matches in the table on your Student Guide.

A Cell is Like a...

Cell Part or Substance		Part of the Analogy	Because...
The Mitochondria...	...is/are like...		
The Nucleus...			
The Cell Membrane...			
Sugar...			
Proteins...			

Explain

Developing Models - A Visual Model

Individually, construct a diagram, mindmap, or flowchart to show how the different parts of a cell work together for the function of the whole cell.

Key Terms to Use:

Nucleus, Cell Membrane, Mitochondria, Sugar, Proteins, Energy, Instructions

Structure and Function: At the bottom, explain how each cell part contributes to the whole cell's function.

Elaborate

Stronger Clearer

1. **Individual Think Time:** What will you say to your partner without looking at your model?

2. **Partner Discussions:**
   a. **Student A:** Describe your model.
   b. **Student B:** Listen and ask clarifying questions.
   c. **Student A and Student B:** Write down any notes to make your model stronger and clearer.

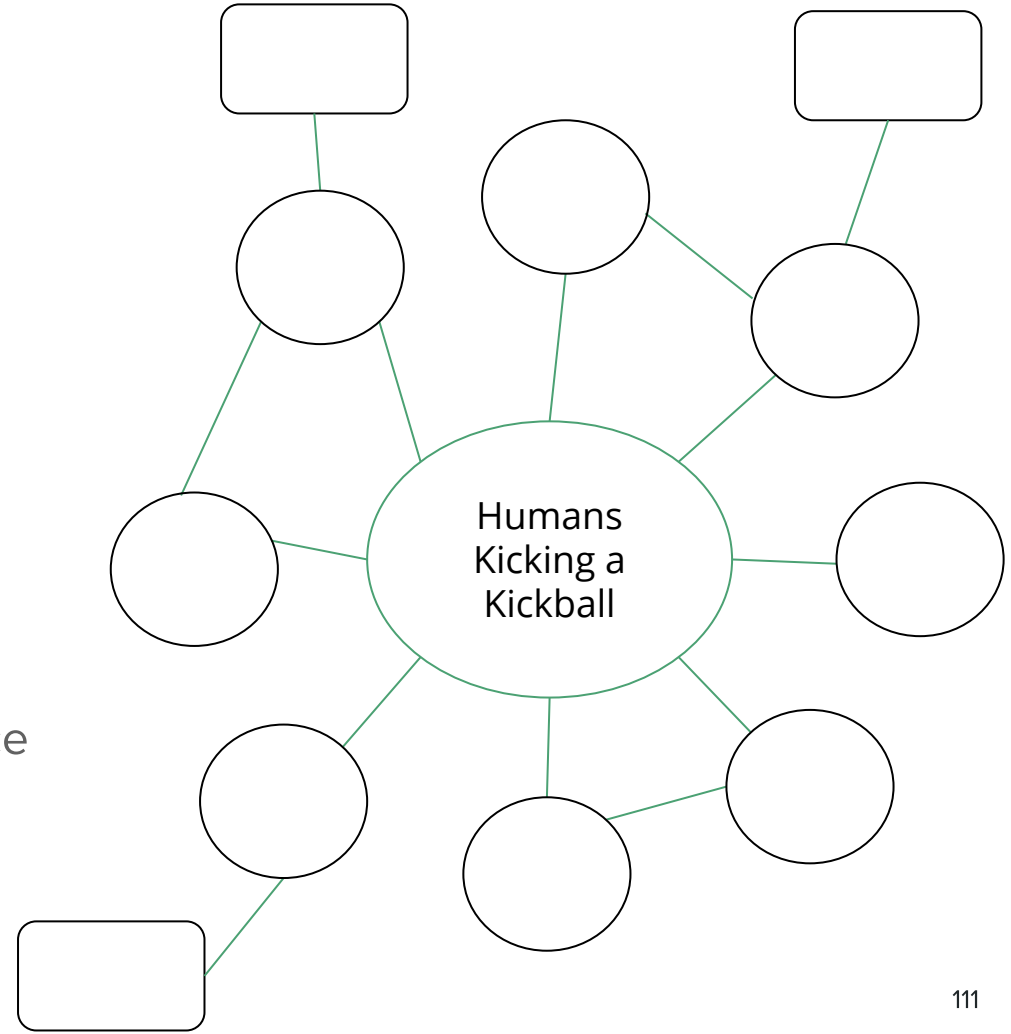
3. **Repeat with 2 more partners!**

4. **Revise your model.**

Class Concept Map

Add to your class concept map:

- New questions (circles)
- New ideas learned (squares)
- New connections (lines and connector words)
- Crosscutting concepts used (trace in color)
    - Structure and Function



Evaluate

Connecting to the Culminating Project

You have been asked to teach people how their bodies make the movement of objects possible in a specific activity. We know from Task 1 that your activity requires energy to move an object.

- ➢ Now that you have learned about cells and their parts, describe where this energy comes from.
- ➢ Pick one body system involved in your activity and do research to fill out the flowchart in your Project Organizer. This will show how energy from your body is able to move your object!

Complete this **individually** in your Project Organizer.

Reflection

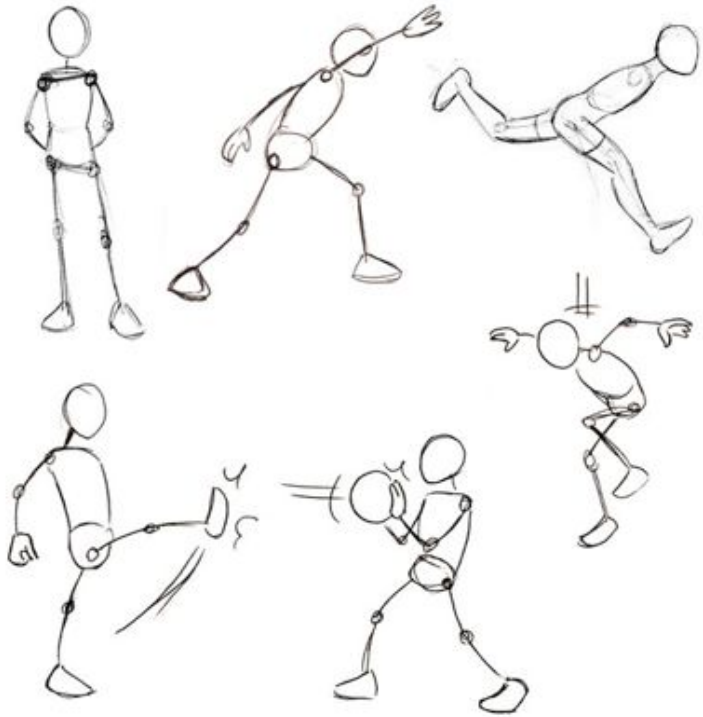
Complete the questions at the end of your student guide to reflect on what you have learned in Task 5.

Culminating Project

Teach people how their bodies make the movement of objects possible!

Group Project - Presentation that demonstrates and analyzes a physical activity

Individual Project - A brochure explaining all the science behind a physical activity



Don’t forget to use your checklist of criteria!

Group Project Criteria for Success

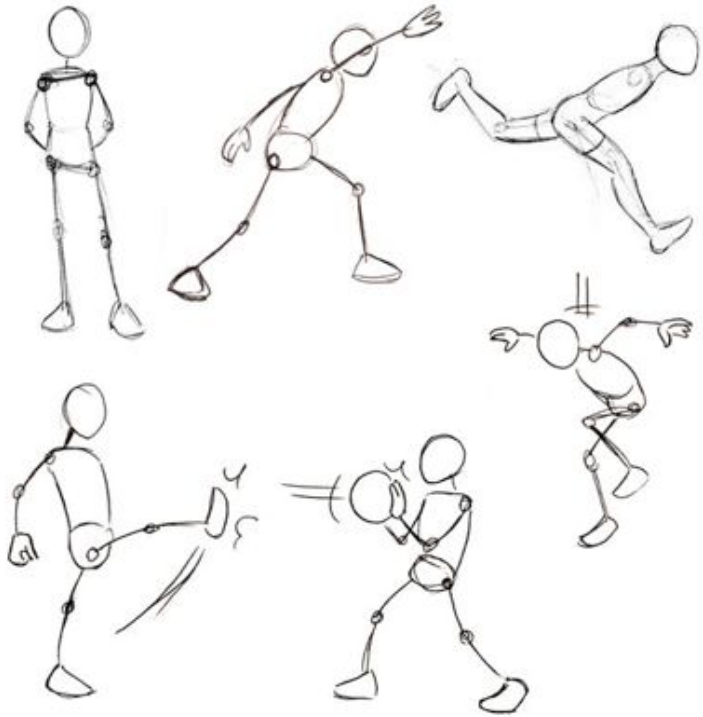
Your activity presentation/video should include:

- ☐ A physical demonstration of the activity
- ☐ An explanation of where the energy comes from that moves the object
  - And a recommendation for how you could change the movement of that object (e.g. make it go faster/slower or farther/faster)
- ☐ A description of the body’s nervous system pathway that results in the object’s motion
- ☐ An explanation of how different body systems interact to make the activity possible
- ☐ Quality Presentation Structure
  - Pauses throughout the physical demonstration to explain the science behind what is happening
  - Is organized logically
  - Is interesting to the audience

Teach people how their bodies make the movement of objects possible!

Group Project - Presentation that demonstrates and analyzes a physical activity

Individual Project - A brochure explaining all the science behind a physical activity



Optional Template

Activity Brochure Template

(First Page When Opened)	*(Back Cover)*	*(Front Cover)*
Optional diagram showing how the motion of the object can vary An argument for why the motion of the object can vary, including the relationship between kinetic energy and energy transfer as well as supporting evidence.	Additional Information or Suggestions for Your Audience	**Title of Activity** Your Name Diagram of physical activity and object in motion

Don’t forget to use your checklist of criteria!

Individual Project Criteria for Success

The brochure should include:

- ☐ A diagram and description of the physical activity and object in motion
- ☐ An argument for why the motion of the object can vary: What is the relationship between kinetic energy and energy transfer? How do you know when the kinetic energy of the object changes?
  - Support the argument with relevant evidence
- ☐ A description or labeled diagram of the nervous system pathway that causes your object to move
  - Cite the sources you used to predict that this is the nervous system pathway used in your activity
- ☐ An argument for how subsystems of the body interact to make the activity possible. Include:
  - A description of each subsystem’s function
  - An explanation and/or diagram showing how the subsystems interact
- ☐ An explanation of where the energy to move the object actually comes from in the human body. To support your explanation, include a model that shows:
  - Different cell parts (e.g. nucleus, cell membrane, and mitochondria) and their specific functions
  - How the function of the whole cell depends on relationships between these cell parts

Peer Review

Brochure Peer Review Feedback

Complete after you have a full first draft of your brochure.

Brochure Owner's Name	
Brochure Reviewer's Name	

Review the following sections of the Brochure:

- ☐ A diagram and description of the physical activity and object in motion
  - ➢ Positive Comment:
  - ➢ Constructive Comment:
- ☐ An argument for why the motion of the object can vary: What is the relationship between kinetic energy and energy transfer? How do you know when the kinetic energy of the object changes?
  - o Support the argument with relevant evidence
  - ➢ Positive Comment:
  - ➢ Constructive Comment:
- ☐ A description or labeled diagram of the nervous system pathway that causes your object to move
  - o Cite the sources you used to predict that this is the nervous system pathway used in your activity
  - ➢ Positive Comment:
  - ➢ Constructive Comment:
- ☐ An argument for how subsystems of the body interact to make the activity possible. Include:
  - o A description of each subsystem's function
  - o An explanation and/or diagram showing how the subsystems interact
  - ➢ Positive Comment:
  - ➢ Constructive Comment:
- ☐ An explanation of where the energy to move the object actually comes from in the human body. To support your explanation, include a model that shows:
  - o Different cell parts (e.g. nucleus, cell membrane, and mitochondria) and their specific functions
  - o How the function of the whole cell depends on relationships between these cell parts
  - ➢ Positive Comment:
  - ➢ Constructive Comment: