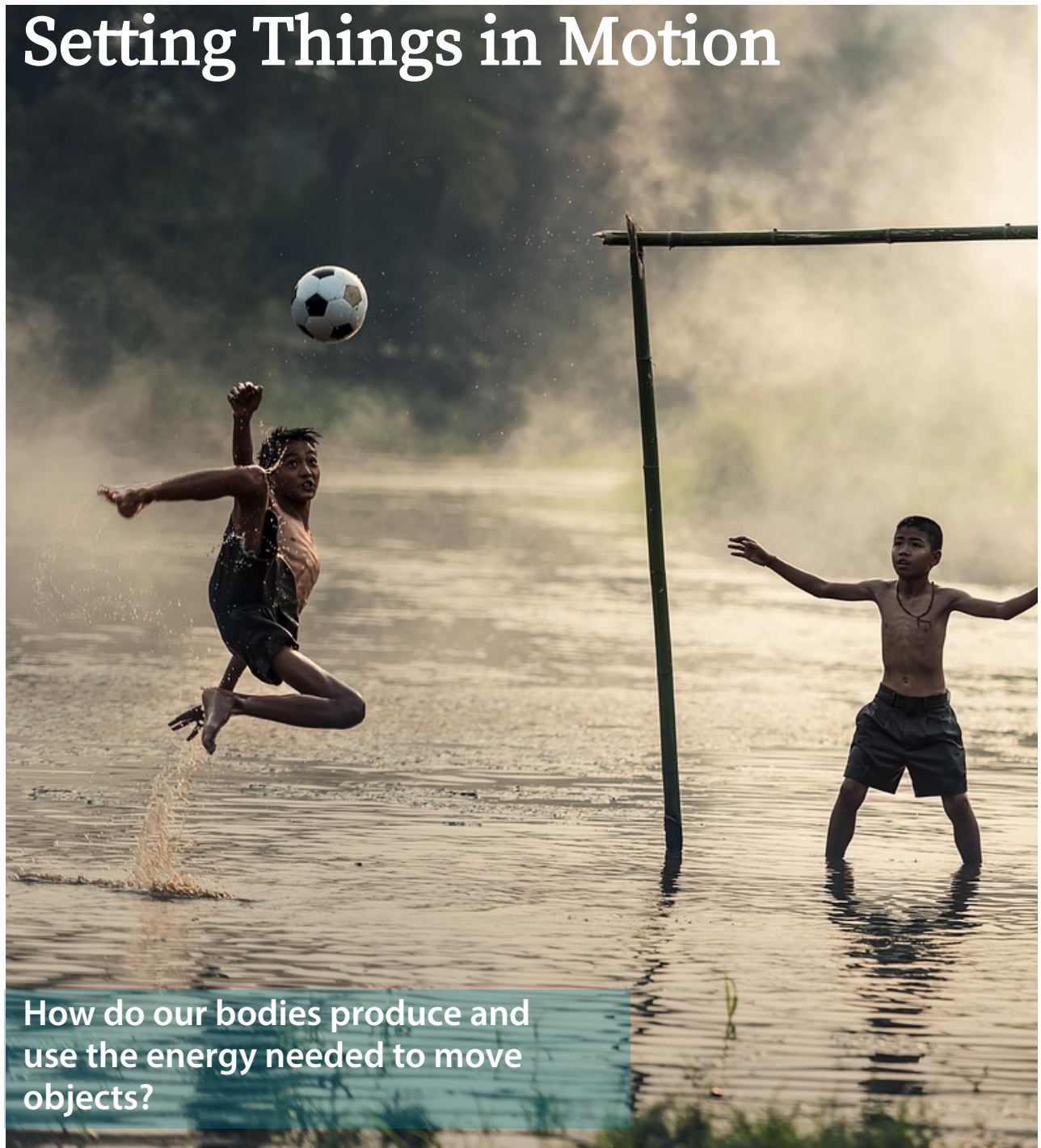


UNIT 1

Setting Things in Motion



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

SCALE

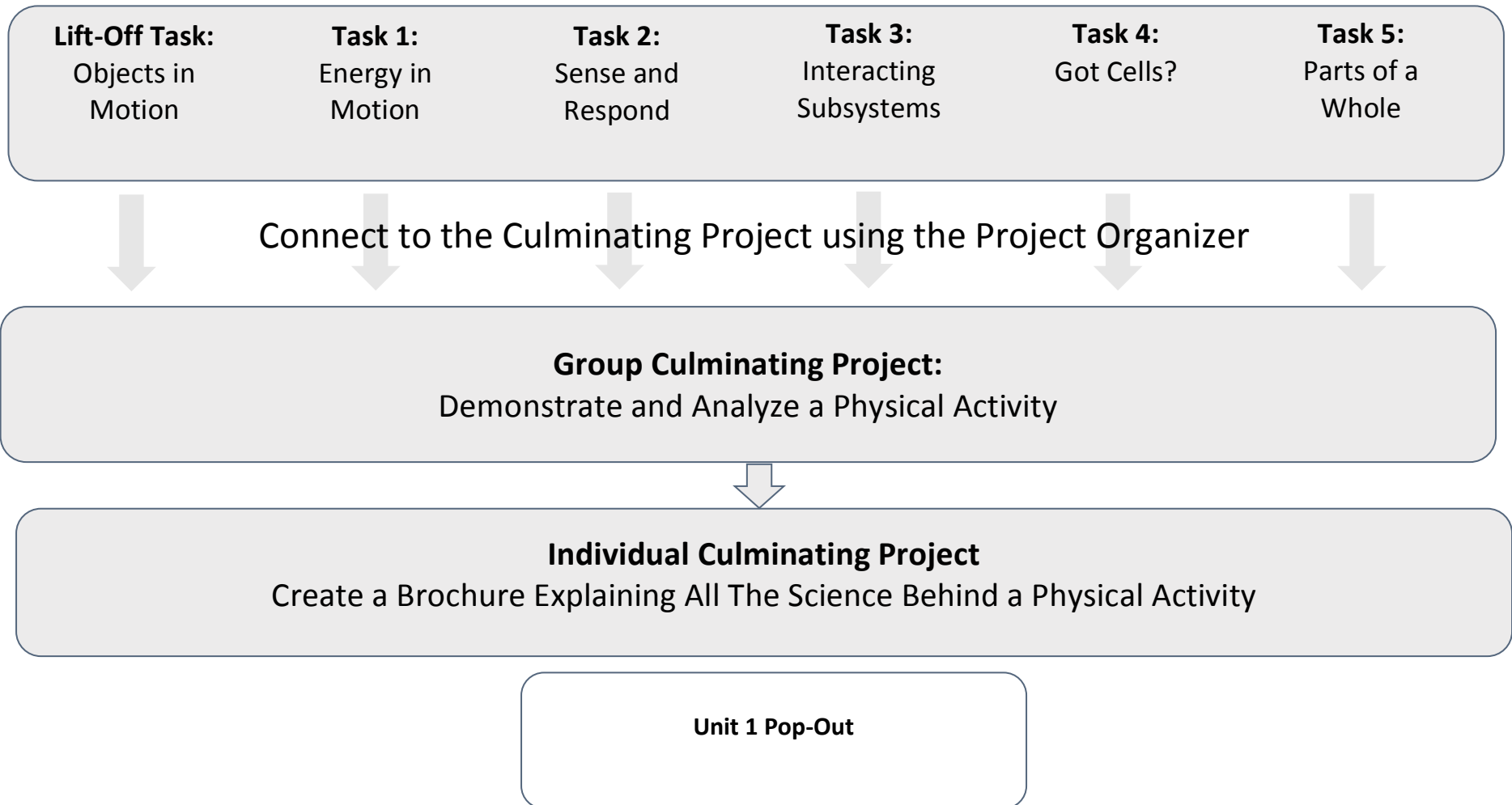
Stanford Center for Assessment,
Learning & Equity



Stanford NGSS Integrated Curriculum: An Exploration of a Multidimensional World
Unit 1: Setting Things in Motion

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

Total Number of Instructional Days: 30.5



6th Grade Science Unit 1: Setting Things in Motion

Unit Overview

Storyline for Unit 1

Every day, students make objects move without thinking twice about how it works. They move food from plates to their mouths as they eat. They pull out chairs to sit down in their classrooms. They kick or throw balls around in the schoolyard at recess. In this unit, students will be exploring how their bodies are able to make objects move. They will consider how their bodies are able to produce energy and how it is transferred to objects.

In the Lift-Off Task, students start with the actual experience of kicking a kickball. By considering the phenomenon of humans moving a kickball, students can begin to generate questions about how our bodies make objects move. The questions they generate will guide them throughout the unit as they continue to make sense of this phenomenon, so they can apply it to their own choice of physical activity in their culminating project.

Before students delve into how the body is involved in actions like kicking a kickball, we first want them to understand the science behind the motion itself. In Task 1, students explore how the kinetic energy of an object changes when energy is transferred or transformed to or from the object. Through investigations, they will learn to identify changes in kinetic energy by noticing observable features, such as motion, temperature, and sound. By the end of this task, students will be able to explain what is needed to change the motion of the object in their chosen activity for their culminating project.

In Task 2, students transition away from the physics concepts involved to think about how their bodies are able to move objects. To begin to make this connection between their bodies and moving objects, students first explore the nervous system—specifically the pathway signals take in order for the body to sense and respond to its environment in the kinds of activities they are focusing on for their culminating projects. After synthesizing information on nervous system pathways, students will have a variety of new scientific terminology to describe what is happening in their culminating project activity.

In Task 3, students broaden their understanding of the human body to consider what other subsystems might also be at work. After gathering evidence from experiments and articles, students are able to refute the argument that only two body systems work together during exercise. By the end of this task, students will be able to show and describe how all body systems interact to do both exercise and their chosen activity for their culminating project.

So far in this unit, students have explored the energy involved in moving objects and the different body systems that interact to put objects in motion. However, they still have not completely connected these two concepts—Where do our bodies actually make the energy that we transfer to these objects? Students will explicitly dig into this question in Task 5 as they look at cell parts, but in order to do so, students first need to understand that the human body they have been examining is made up of cells. In Task 4, students zoom in to the microscopic scale and look at the human body up close; here, they discover that only living things are made up of cells. By the end of this task, students will be prepared to research the types of cells involved in their activity and explain why they look different, but are all still referred to as cells.

Task 5 continues their exploration of the microscopic scale by diving into the function of a cell as a whole and the ways in which parts of the cell contribute to the function. This provides the final link for students to think about why their bodies are able to put objects in motion in different activities. By developing and using different types of models, students discover that there is a specific part of the cell that produces energy for the cell, allowing it to function. This is the energy that students eventually see in the movement of objects in their chosen activity for their culminating project.

**6th Grade Science Unit 1: Setting Things in Motion
Unit Overview**

Once students have completed all tasks and their Project Organizers, they can begin work on their culminating project. Students have already picked an activity that involves an object in motion. In this culminating project, their job is to explain to people who do this activity how their bodies actually make the movement of the object possible. Each group will create a video or presentation that not only demonstrates the activity, but also pauses throughout to describe the role of the human body in making the motion happen. Individually, they will then create a brochure to give more detail on the science involved in the human body putting an object in motion.

**6th Grade Science Unit 1: Setting Things in Motion
Unit Overview**

Three-Dimensional Breakdown of the Performance Expectations

This unit was developed to align with, teach, and assess students’ understanding and skills related to these Performance Expectations. Below, we have mapped out the disciplinary core ideas, crosscutting concepts, and science and engineering practices addressed in this unit. Aspects of the dimensions that are not explicitly addressed in this unit are crossed out.

Performance Expectations	Scientific and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. <i>[Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]</i></p>	<p>Engaging in Argument From Evidence</p> <ul style="list-style-type: none"> Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. 	<p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> When the motion energy of an object changes, there is inevitably some other change in energy at the same time. 	<p>Energy and Matter</p> <ul style="list-style-type: none"> Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
<p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. <i>[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]</i></p>	<p>Obtaining, Evaluating, and Communicating Information</p> <ul style="list-style-type: none"> Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. 	<p>LS1.D: Information Processing</p> <p>Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.</p>	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems.
<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. <i>[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems</i></p>	<p>Engaging in Argument From Evidence</p> <ul style="list-style-type: none"> Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. 	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. 	<p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

**6th Grade Science Unit 1: Setting Things in Motion
Unit Overview**

<p>within a system and the normal functioning of those systems.] <i>[Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]</i></p>			
<p>MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. <i>[Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]</i></p>	<p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. 	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). 	<p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Phenomena that can be observed at one scale may not be observable at another scale.
<p>MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. <i>[Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]</i></p>	<p>Developing and Using Models</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena. 	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. 	<p>Structure and Function</p> <ul style="list-style-type: none"> Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function.

**6th Grade Science Unit 1: Setting Things in Motion
Unit Overview**

Connections to Common Core Math and ELA Standards:

Over the course of this unit, students will gain knowledge and skills in science, as well as in math and English-Language Arts. Below we list the Common Core ELA and Math standards for middle school and 6th grade that are relevant to the curriculum tasks in this unit. Within the curriculum, there are opportunities to incorporate components of the following ELA and Math Standards:

Middle School and 6th Grade Common Core ELA Standards		Unit Task
Integration of Knowledge and Ideas	CCSS.ELA-Literacy.RI.6.8: Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.	Task 3 Task 4
Key Ideas and Details	CCSS.ELA-Literacy.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.	Task 1 Task 2 Task 3 Culminating Project
Text Types and Purposes	CCSS.ELA-Literacy.WHST.6-8.1: Write arguments focused on discipline-specific content.	Task 1 Task 3 Culminating Project
Research to Build and Present Knowledge	CCSS.ELA-Literacy.WHST.6-8.7: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.	Task 4 Task 5
	CCSS.ELA-Literacy.WHST.6-8.8: Gather relevant information from multiple print and digital sources, using search terms effectively.	Culminating Project
Presentation of Knowledge and Ideas	CCSS.ELA-Literacy.SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.	Task 5 Culminating Project

Middle School and 6th Grade Common Core Math Standards		Unit Task
Mathematical Practice	CCSS.MATH.MP.2: Reason abstractly and quantitatively.	Task 1 Task 2 Task 3
Ratios and Proportional Relationships	CCSS.MATH.CONTENT.6.RP.A.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.	Task 1 Culminating Project

**6th Grade Science Unit 1: Setting Things in Motion
Unit Overview**

Connections to English Language Development (ELD) Standards:

We acknowledge that language development is a key component of disciplinary understanding and helps to support more rigorous and equitable outcomes for diverse students. This curriculum thus takes into account both the receptive and productive language demands of the culminating projects and strives to increase accessibility by including scaffolds for language development and pedagogical strategies throughout learning tasks. We aim to support language acquisition through the development of concept maps; utilizing sentence frames; implementing the Critique, Correct, Clarify technique; employing the Stronger Clearer strategy; and fostering large and small group discussions.

The California ELD Standards are comprised of two sections: the standards and a rubric. Outlined below are the standards from Section One that are met within this curriculum. For additional information, please refer to: https://www.pausd.org/sites/default/files/pdf-faqs/attachments/SS_ELD_6.pdf.

6 th Grade ELD Standards		
Part I: Interacting in Meaningful Ways	A: Collaborative	1. Exchanging information and ideas with others through oral collaborative discussions on a range of social and academic topics
		2. Interacting with others in written English in various communicative forms (print, communicative technology, and multimedia)
		3. Offering and justifying options, negotiating with and persuading others in communicative exchanges
		4. Adapting language choices to various contexts (based on task, purpose, audience, and text type)
	B: Interpretive	5. Listening actively to spoken English in a range of social and academic contexts
		6. Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language
		7. Evaluating how well writers and speakers use language to support ideas and arguments with details or evidence depending on modality, text type, purpose, audience, topic, and content area
		8. Analyzing how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area
	C: Productive	9. Expressing information and ideas in formal oral presentations on academic topics
		10. Writing literary and informational texts to present, describe, and explain ideas and information, using appropriate technology
		11. Justifying own arguments and evaluating others' arguments in writing
		12. Selecting and applying varied and precise vocabulary and other language resources to effectively convey ideas
Part II: Learning About How English Works	A: Structuring Cohesive Texts	1. Understanding text structure
		2. Understanding cohesion
	B: Expanding and Enriching Ideas	3. Using verbs and verb phrases
		4. Using nouns and noun phrases
		5. Modifying to add details
	C: Connecting and Condensing Ideas	6. Connecting ideas
		7. Condensing ideas

6th Grade Science Unit 1: Setting Things in Motion

Unit Overview

Connections to Environmental Awareness:

Over the course of this curriculum, students will explore content related to various environmental principles and concepts that examine the interactions and interdependence of human societies and natural systems. In accordance with the *Education and the Environment Initiative (EEI)*, tasks throughout this curriculum explore many of *California's Approved Environmental Principles and Concepts*.

Because this unit focuses on the human body and how it can move objects, it does not explicitly examine the interactions of *humans* and natural systems. In later units, we will outline the EEI principles relevant to the unit in this section of the unit overview.

6th Grade Science Unit 1: Setting Things In Motion

Teacher Materials List

Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Overall Unit – All Tasks

- Unit 1, Task Cards Student Version, Lift-Off and Tasks 1 through 5
- Culminating Project Student Task Card
- Project Organizer
- Projector with Audio (for video or images, whenever needed)

Lift-Off Task (2 days, based on 45-minute periods)

Per Student

- Task Card Student Version: Lift-Off
- Post-Its (Optional)
- Task Card Student Version: Culminating Project
- Project Organizer

Per Group

- Poster paper and markers

Whole Class

- Kickball(s)
- Poster paper and markers
- *See Instructions in Lift-Off for other optional materials to use for the class concept map

Task 1 (3.5 days, based on 45-minute periods)

Per Student

- Task Card Student Version: Task 1
- Project Organizer

Per Group

- Books or other items that can be stacked
- Ball/Marble
- Pipe insulation, cut open to make a track
- 20 pennies

Task 2 (4.5 days, based on 45-minute periods)

Per Student

- Task Card Student Version: Task 2
- Project Organizer
- Nervous System Definition Cards and Scissors

Per Pair

- Ruler
- Optional: Reflex Hammer

Per Group

- Nervous System Video and Simulation Instructions
- Computers (if showing *Explore* video as a group)

6th Grade Science Unit 1: Setting Things In Motion

Teacher Materials List

- Optional: Role Cards for Nervous System Simulation

Whole Class

- Projector/Speakers (if showing *Explore* video as a whole class)

Task 3 (4 days, based on 45-minute periods)

Per Student

- Task Card Student Version: Task 3
- Project Organizer
- Article – *Subsystems of the Body*

Per Group

- 4 blank pieces of paper
- Timer – phone, watch, stopwatch
- Poster Paper
- Markers

Whole Class

- Projector and Activity Photos

Task 4 (3.5 days, based on 45-minute periods)

Per Student

- Task Card Student Version: Task 4
- Project Organizer

Per Station

- *Microscope Station* Cards (2-3 per station)

Task 5 (4 days)

Per Student

- Task Card Student Version: Task 5
- Project Organizer

Per Group

- *Cell Definition Cards*, cut
- *Cell Analogy*

Culminating Project (9 days, based on 45-minute periods)

Presentation/Video

- Device with Video Recording
- Video Editing/Creation Software (e.g. iMovie, Sparkol VideoScribe, PowToons, etc.)
- Props (e.g. ball)
- Poster Paper
- Color pencils/markers or computer graphics

Brochure

- Blank Paper or Computer Program
- Color pencils/markers or computer graphics

6th Grade Science Unit 1: Setting Things in Motion
Building on Prior Knowledge

This sixth grade curriculum begins with a unit that connects two of the three disciplines—life science and physical science. In this unit, students consider how their own bodies work in order to think more deeply about the interaction between systems in the human body when doing physical activities. In this culminating project, students are asked to pick an activity that involves an object in motion and explain how their bodies make the movement of this object possible.

The integrated model requires students to access and use a wide range of ideas from prior grades. This content knowledge spans three different Disciplinary Core Ideas in this unit: PS3.B: Conservation of Energy and Energy Transfer, LS1.A: Structure and Function, and LS1.D: Information Processing.

As students explore these core ideas, they build on their skills in the following science and engineering practices: Developing and Using Models; Planning and Carrying Out Investigations; Engaging in Argument From Evidence; and Obtaining, Evaluating, and Communicating Information. In addition to science and engineering practices, students also continue to build on their knowledge of the following crosscutting concepts: Cause and Effect; Scale, Proportion, and Quantity; Systems and System Models; Energy and Matter; and Structure and Function.

*This summary is based on information found in the NGSS Framework.

K-8 Progression of Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts for Unit 1

Disciplinary Core Ideas	K-2	3-5	6-8
PS3.B Conservation of Energy and Energy Transfer	Sunlight warms Earth’s surface.	Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.
LS1.A Structure and Function	All organisms have external parts that they use to perform daily functions.	Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.
LS1.D Information Processing	Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.

6th Grade Science Unit 1: Setting Things in Motion
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Science and Engineering Practices	K-2	3-5	6-8
Developing and Using Models*	Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. <ul style="list-style-type: none"> Develop and/or use a model to represent amounts, relationships, relative scales (bigger/smaller), and/or patterns in the natural and designed world(s). 	Modeling in 3-5 builds on prior experiences and progresses to building and revising simple models and using models to represent events and design solutions. <ul style="list-style-type: none"> Develop and/or use models to describe and/or predict phenomena. 	Modeling in 6-8 builds on prior experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. <ul style="list-style-type: none"> Develop and use model to describe phenomena.
Planning and Carrying Out Investigations*	Planning and carrying out investigations in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. 	Planning and carrying out investigations in 3-5 builds on prior experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. <ul style="list-style-type: none"> Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. 	Planning and carrying out investigations in 6-8 builds on prior experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. <ul style="list-style-type: none"> Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.
Engaging in Argument From Evidence*	Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). <ul style="list-style-type: none"> Construct an argument with evidence to support a claim. 	Engaging in argument from evidence in 3-5 builds on prior experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). <ul style="list-style-type: none"> Construct and/or support an argument with evidence, data, and/or a model. Use data to evaluate 	Engaging in argument from evidence in 6-8 builds on prior experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). <ul style="list-style-type: none"> Construct, use, and/or present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.

6th Grade Science Unit 1: Setting Things in Motion
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		claims about cause and effect.	
Obtaining, Evaluating, and Communicating Information*	<p>Obtaining, evaluating, and communicating Information in K-2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. 	<p>Obtaining, evaluating, and communicating Information in 3-5 builds on prior experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. 	<p>Obtaining, evaluating, and communicating Information in 6-8 builds on prior experiences and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

*These SEPs are summatively assessed using the Culminating Project or a Task-Specific Rubric.

Crosscutting Concepts	K-2	3-5	6-8
Cause and Effect*	<p>Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.</p> <ul style="list-style-type: none"> Events have causes that generate observable patterns. 	<p>Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.</p> <ul style="list-style-type: none"> Cause and effect relationships are routinely identified, tested, and used to explain change. 	<p>Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Scale, Proportion, and Quantity*	<p>Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.</p> <ul style="list-style-type: none"> Relative scales allow 	<p>Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time,</p>	<p>Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of</p>

6th Grade Science Unit 1: Setting Things in Motion
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	<p>objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower).</p>	<p>temperature, and volume.</p> <ul style="list-style-type: none"> Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. 	<p>natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.</p> <ul style="list-style-type: none"> Phenomena that can be observed at one scale may not be observable at another scale.
Systems and System Models*	<p>Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.</p> <ul style="list-style-type: none"> Objects and organisms can be described in terms of their parts. Systems in the natural and designed world have parts that work together. 	<p>Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.</p> <ul style="list-style-type: none"> A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A system can be described in terms of its components and their interactions. 	<p>Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of a larger complex system.
Energy and Matter*	N/A	<p>Students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.</p> <ul style="list-style-type: none"> Energy can be transferred in various ways and between objects. 	<p>Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn that within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.</p> <ul style="list-style-type: none"> Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion).
Structure and Function*	<p>Students observe the shape and stability of structures of natural and designed objects are related to their function(s).</p> <ul style="list-style-type: none"> The shape and stability 	<p>Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions.</p>	<p>Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural</p>

6th Grade Science Unit 1: Setting Things in Motion
Building on Prior Knowledge



	<p>of structures of natural and designed objects are related to their function(s).</p>	<ul style="list-style-type: none"> • Substructures have shapes and parts that serve functions. 	<p>and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.</p> <ul style="list-style-type: none"> • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function.
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*These CCCs are summatively assessed using the Culminating Project or a Task-Specific Rubric.

Progression of Knowledge from Kindergarten – 8th grade

PS3.B. Conservation of Energy and Energy Transfer: In Kindergarten through second grade, students are first introduced to the idea of energy transfer by making observations of how sunlight warms the Earth’s surface and designing a device that can minimize this energy transfer. In third – fifth grade, students broaden their definition of energy from light and heat to include other indicators of energy (e.g., motion, sound, or electrical energy). As they investigate these types of energy, they also conceptualize how energy can be transferred between objects, resulting in different types of observable evidence. For example, when moving objects collide, energy is transferred to the surrounding air, producing heat and sound. This sets the foundation for this sixth grade unit, in which students use their knowledge of observable forms of energy to consider how energy transfers between objects are also associated with changes in kinetic energy. Later in this sixth grade unit, students will dive into two other Performance Expectations associated with this DCI, which focus on the relationship between thermal energy and kinetic energy of particles. While there is a clear focus on the CCC of Energy and Matter in this DCI, students also build their understanding of Cause and Effect and Scale, Proportion, and Quantity at different grade levels. Throughout all grade bands, there is a focus on the SEPs of Asking Questions, Planning and Carrying Out Investigations, and Designing Solutions.

The following is the progression of the Performance Expectations for this DCI:

- K-PS3-1** Make observations to determine the effect of sunlight on Earth’s surface.
- K-PS3-1** Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
- 4-PS3-2** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electrical currents.
- 4-PS3-3** Ask questions and predict outcomes about the changes in energy that occur when objects collide.

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- 4-PS3-4** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- MS-PS3-3** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- MS-PS3-4** Plan an investigation to determine the relationships among the energy transferred and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
- MS-PS3-5** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

LS1.A. Structure and Function: In Kindergarten through second grade, students are introduced to the concept of structure and function by thinking about how plants and animals have specific external parts that help them survive and grow. At this level, students are using these examples to mimic them in a design of their own. In fourth grade, students continue their exploration of the same concept but instead gather evidence to support an argument that both internal and external structures do in fact support survival, growth, behavior, and reproduction. This connection between the structures and functions of living things provides a solid foundation for this sixth grade unit, in which students consider structure and function within the context of the human body—how living things are made of cells, how cells have special structures for specific functions, and how the body has different sub-systems with specific functions that work together. The SEPs and CCCs vary widely from Kindergarten to Middle School, but the CCCs of Structure and Function and Systems and System Models show up multiple times throughout the grand bands.

The following is the progression of the Performance Expectations for this DCI:

- 1-LS1-1** Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
- 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- MS-LS1-1** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
- MS-LS1-2** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- MS-LS1-3** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

LS1.D. Information Processing: Kindergarten through second grade introduces this DCI with the same PE as LS1.A. Structure and Function. While the language of this PE implies a much greater focus on the concept of structure and function, the inclusion of this DCI emphasizes that some of these plant and animal structures function specifically to capture and convey different types of information. This sets the stage for students to delve more deeply into the neural

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pathways they may have implicitly studied in the K-2 grade band. In fourth grade, the neural pathway is basic—senses to brain to response. However, in this sixth grade unit, students expand on this process further, considering the different inputs and how they are transmitted as signals along nerve cells to the brain, processed, and sent back out along nerve cells to create a response. The SEPs and CCCs for this DCI are varied, with no specific focus throughout.

- 1-LS1-1** Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
- 4-LS1-2** Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
- MS-LS1-8** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

**6th Grade Science Unit 1: Setting Things in Motion
Culminating Project**

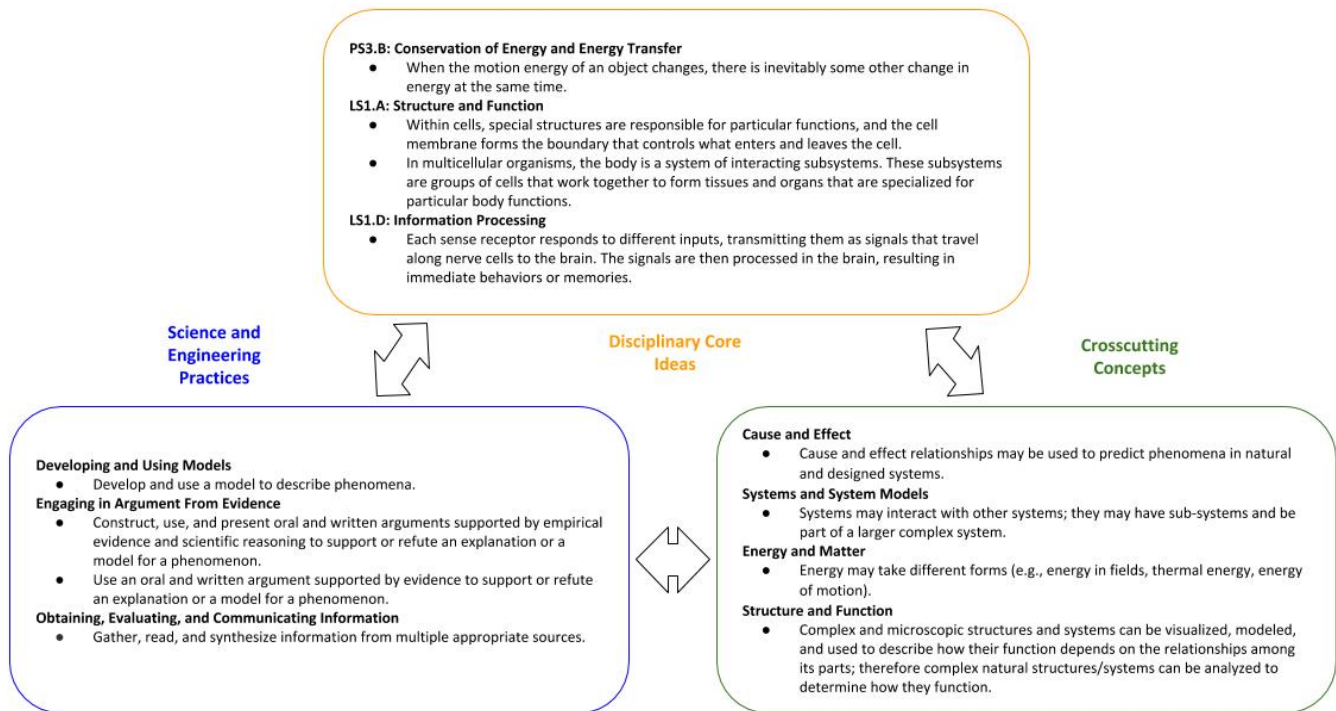
Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

Students use their bodies every day for a range of different activities without thinking twice about it. Many of these activities involve putting various objects in motion. In the Lift-Off task, students experienced how their bodies are able to make a kickball move. But what makes objects move? Where does the energy come from? And what is happening in humans’ bodies that make this movement possible?

In this project, each group will pick an activity that involves an object in motion and explain to people who do this activity how their bodies actually make the movement of the object possible. At the end of the unit, each group will create a video or presentation that not only demonstrates the activity, but also pauses throughout to describe the role of the human body in making the motion happen. Individually, they will then create a brochure to give more detail on the science involved in the human body putting an object in motion.

3-Dimensional Assessment



*To maintain the authenticity of the Culminating Project, MS-LS1-1 is assessed in Task 4.

Time Needed (Based on 45-Minute Periods)

9 days at end of unit

- Group Project: 4 periods (includes 1 presentation day)
- Individual Project: 5 periods
 - First draft: 3 periods
 - Feedback: 1 period
 - Revision: 1 period

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Culminating Project**



Materials

Presentation/Video

- Device with Video Recording
- Video Editing/Creation Software (e.g. iMovie, Sparkol VideoScribe, PowToons, etc.)
- Props (e.g. ball)
- Poster Paper
- Color pencils/markers or computer graphics

Brochure

- Blank Paper or Computer Program
- Color pencils/markers or computer graphics

Instructions for the Culminating Project

1. Introduce the Culminating Project at the end of the Lift-Off task, including both group and individual components outlined in the Challenge.
2. Read over the Culminating Project Task Card with students. We recommend only reading the Challenge and Group Project Criteria for Success at this time in order to not overwhelm students with information.
 - Take questions for clarification.
 - Optional: You may want to explain the different format options available for their group project (e.g., live presentation with props and posters, video using basic recording of presentation, whiteboard video using Sparkol VideoScribe, video using Powtoons, etc.)
3. Remind students as they complete the Project Organizer that they will be planning pieces of their presentation and recording scientific concepts they will likely need for their individual project. However, there is nothing wrong with going back and changing their ideas over the course of the unit. The students won't fully design their presentation until the end of the unit, so change during the imaginative and creative time is acceptable and often experienced.
4. Make sure the students fill out the Project Organizer after each task, which will help the students think about different parts of their presentation along the way. This process allows students to both apply and document relevant scientific concepts as they move throughout the unit. This will inform both their group and individual projects.
 - We recommend that students complete the Project Organizer individually, with the exception of choosing a physical activity after Task 1 as a group. They might discuss ideas first as a group, but should then respond individually. This allows students time to process concepts on their own and generate their own ideas, which can be used later when it comes to developing their group project.
5. The table below summarizes how the Project Organizer guides the students through developing different components of their activity presentation (group product) and brochure (individual product).

Task	Project Organizer	Group and Individual Culminating Project
Lift Off Objects in Motion	<ul style="list-style-type: none"> • Brainstorm a list of activities that involve putting an object in motion. 	<ul style="list-style-type: none"> • Group: A physical demonstration of the activity

**6th Grade Science Unit 1: Setting Things in Motion
Culminating Project**



		<ul style="list-style-type: none"> Individual: A diagram and description of the physical activity and object in motion
<p>Task 1 Energy in Motion</p>	<ul style="list-style-type: none"> Decide on an activity for the group culminating project. 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). Cite evidence from your argument or investigations to support your explanation. 	<ul style="list-style-type: none"> Group: A recommendation for how you could change the movement of the object Individual: An argument for why the motion of the object can vary, including the relationship between kinetic energy and energy transfer as well as observable evidence
<p>Task 2 Sense and Respond</p>	<ul style="list-style-type: none"> Describe the nervous system pathway involved in your chosen activity, using a flowchart with labels, numbered list, or paragraph. 	<ul style="list-style-type: none"> Group: A description of the body’s nervous system pathway that results in the object’s motion Individual: A description or labeled diagram of the nervous system pathway that causes their object to move, including citation of sources
<p>Task 3 Interacting Subsystems</p>	<ul style="list-style-type: none"> In a paragraph, flowchart, or diagram, explain how different subsystems of the body work together to do your chosen activity. 	<ul style="list-style-type: none"> Group: An explanation of how different body systems interact to make the activity possible Individual: An argument for how subsystems of the body interact to make the activity possible
<p>Task 4 Got Cells?</p>	<ul style="list-style-type: none"> Research and identify the types of cells that make up these 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? 	<ul style="list-style-type: none"> Group: N/A Individual: N/A <p>*This PE, MS-LS1-1, is assessed within Task 4.</p>
<p>Task 5 Parts of a Whole</p>	<ul style="list-style-type: none"> Now that you have learned about cells and their parts, describe where the energy to move objects comes from. 	<ul style="list-style-type: none"> Group: An explanation of where the energy comes from that moves the object Individual: An explanation of where the energy to move the object actually comes from in the human body. Supported by a model that shows the interaction of cell parts for overall cell function.

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Culminating Project

6. After all the learning tasks and the Project Organizer are completed, the students can start to design the presentation of their activity in live or video format. The Project Organizers and Group Project Criteria for Success should be used as reference to remind students to include all the components of their presentation.
 - As always, we recommend the use of group roles for Culminating Project work time (See “How to Use This Curriculum” for details). We recommend changing the roles every work day.
7. Once class presentations are complete and have been exhibited, students are ready to move on to their individual project. Each student will create a brochure that explains the science behind their activity in more detail and meets all the criteria in the student handout. An optional template is provided at the end of this document to help students organize their brochure.
8. Conduct a peer review of the brochures after students have completed a first draft.
 - Copy the Brochure Peer Review Feedback form found in the Student Instructions. Another option is to use the Student 3-Dimensional Individual Project Rubric.
 - Assign each student a partner, preferably a partner from a different group.
 - Students switch drafts and assess them using the peer review feedback form.
 - Remind each student to give one positive comment and one constructive comment for each section on the checklist.
 - Allow students time to present their feedback to their partner, so their partner may ask clarifying questions if needed.
9. After receiving feedback, allow students time to complete a final draft based on the feedback they received.

Assessment

The Project Organizer can be formatively assessed using:

- *Criteria of your choice*. We recommend using the 3-Dimensional Assessment matrix from the Unit Overview to inform your criteria.

The Group Culminating Project will be summatively assessed using:

- The *Group Project Criteria for Success* Checklist

The Individual Culminating Project will be summatively assessed using:

- The *3-Dimensional Individual Project Rubric*.
- Keep in mind that the Proficient level indicates that the student has successfully demonstrated understanding of the criteria. Because we are in the early stages of NGSS adoption, it may take multiple opportunities throughout the course of the year for students to reach Proficient.
- If you wish to give students a numeric score, you could take the average score of all of their rubrics or add up rubric scores to give students a summation out of the total. Because of the note above, this scoring may not correlate to traditional grading systems.
- While we recommend scoring all of the project criteria with the rubrics for each student, we understand the burden of that level of scoring.

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Culminating Project**

- One option is to select the rubrics that you wish to focus on for this project and use those to assess each student's individual project.
- Another option is to review the Proficient level of each of the project's rubrics and use the descriptions to generally analyze all student work for trends.

**6th Grade Science Unit 1: Setting Things in Motion
Culminating Project**



Activity Brochure Template

<p style="text-align: center;"><i>(First Page When Opened)</i></p> <div style="border: 1px solid black; padding: 20px; margin: 10px auto; width: 80%;"> <p style="text-align: center;">Optional diagram showing how the motion of the object can vary</p> </div> <p style="text-align: center;">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.</p>	<p style="text-align: center;"><i>(Back Cover)</i></p> <p style="text-align: center;">Additional Information or Suggestions for Your Audience</p>	<p style="text-align: center;"><i>(Front Cover)</i></p> <p style="text-align: center;">Title of Activity</p> <p style="text-align: center;">Your Name</p> <div style="border: 1px solid black; padding: 20px; margin: 10px auto; width: 80%;"> <p style="text-align: center;">Diagram of physical activity and object in motion</p> </div>
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**6th Grade Science Unit 1: Setting Things in Motion
Culminating Project**

<i>Left Inside Page</i>	<i>Middle Inside Page</i>	<i>Right Inside Page</i>
<div data-bbox="155 464 709 946" style="border: 1px solid black; padding: 10px; margin-bottom: 10px;"> <p>Labeled diagram of the nervous system pathway that results in the physical activity</p> </div> <p>Any additional information about the nervous system pathway</p> <p>Cite the sources you used to predict that this is the nervous system pathway used in your activity</p> <ul style="list-style-type: none"> ○ Source 1 ○ Source 2 ○ Source 3 	<p>Your argument for how subsystems of the body interact to make the activity possible.</p> <div data-bbox="774 872 1329 1354" style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p>A labeled diagram showing how the subsystems interact</p> </div>	<p>An explanation of where the energy to move the object actually comes from in the human body.</p> <div data-bbox="1394 657 1948 1140" style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p>A model that shows the different cell parts, their specific functions, and how they interact</p> </div> <p>A description of how the function of the whole cell depends on relationships between these cell parts</p>

6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric

Overview: The following rubrics can be used to assess the individual project: a brochure detailing the science involved in the body putting an object in motion. Each rubric is aligned to one section of the *Individual Project Criteria for Success*, located on the Culminating Project Student Instructions. *If student provides no assessable evidence (e.g., “I don’t know” or leaves answer blank), then that student response cannot be evaluated using the rubric and should be scored as a zero.

Below we provide an alignment table that details the dimensions assessed for each criterion.

	Student Criteria for Success	Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
1	<input type="checkbox"/> 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? <ul style="list-style-type: none"> ○ Support the argument with relevant evidence from Task 1 	Engaging in Argument From Evidence <ul style="list-style-type: none"> ● Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. 	PS3.B: Conservation of Energy and Energy Transfer <ul style="list-style-type: none"> ● When the motion energy of an object changes, there is inevitably some other change in energy at the same time. 	Energy and Matter <ul style="list-style-type: none"> ● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
2	<input type="checkbox"/> A description or labeled diagram of the nervous system pathway that results in the physical activity <ul style="list-style-type: none"> ○ Cite the sources you used to predict that this is the nervous system pathway used in your activity 	Obtaining, Evaluating, and Communicating Information <ul style="list-style-type: none"> ● Gather, read, and synthesize information from multiple appropriate sources. 	LS1.D: Information Processing <ul style="list-style-type: none"> ● Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. 	Cause and Effect <ul style="list-style-type: none"> ● Cause and effect relationships may be used to predict phenomena in natural or designed systems.
3	<input type="checkbox"/> An argument for how subsystems of the body interact to make the activity possible. Include: <ul style="list-style-type: none"> ○ A description of each subsystem’s function ○ An explanation and/or diagram showing how the subsystems interact 	Engaging in Argument From Evidence <ul style="list-style-type: none"> ● Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. 	LS1.A: Structure and Function <ul style="list-style-type: none"> ● In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together and are specialized for particular body functions. 	Systems and System Models <ul style="list-style-type: none"> ● Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
4	<input type="checkbox"/> An explanation of where the energy to move the object actually comes from in the human body. To support your explanation,	Developing and Using Models <ul style="list-style-type: none"> ● Develop and use a model to describe phenomena. 	LS1.A: Structure and Function <ul style="list-style-type: none"> ● Within cells, special structures are responsible for particular functions, and 	N/A

**6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric**

	<p>include a model that shows:</p> <ul style="list-style-type: none"> Different cell parts (e.g., nucleus, cell membrane, and mitochondria) and their specific functions 		<p>the cell membrane forms the boundary that controls what enters and leaves the cell.</p>	
5	<ul style="list-style-type: none"> How the function of the whole cell depends on relationships between these cell parts 	N/A	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. 	<p>Structure and Function</p> <ul style="list-style-type: none"> Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function.

**6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric**

Rubric 1: Student uses evidence of observable features to argue that a change in the kinetic energy of their object means more or less energy was transferred to the object.

- Dimensions Assessed: SEP – Engaging in Argument From Evidence, DCI – PS3.B: Conservation of Energy and Energy Transfer, CCC – Energy and Matter

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student constructs an inaccurate or irrelevant argument about the kinetic energy and energy transfer of their object.	Student accurately argues that a change in the kinetic energy of their object means more or less energy was transferred to the object.	Student uses evidence of an observable feature to accurately argue that a change in the kinetic energy of their object means more or less energy was transferred to the object.	Student uses evidence of multiple observable features to accurately argue that a change in the kinetic energy of their object means more or less energy was transferred to the object.
<p>Look Fors:</p> <ul style="list-style-type: none"> • Student constructs an inaccurate argument (e.g., student describes that the kickball travels a shorter distance because more energy was used up in the body). OR • Student constructs an argument that is irrelevant to the physics concepts (e.g., the motion of the kickball can vary depending on how strong the kicker is). 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student accurately describes that the motion of the object can vary because the energy transferred to the object can vary (e.g., the kickball can go shorter or farther depending on how much energy is transferred from the human body). • Student provides no evidence of any observable features (e.g. motion, sound, temperature) 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student accurately describes that the motion of the object can vary because the energy transferred to the object can vary (e.g., the kickball can go shorter or farther depending on how much energy is transferred from the human body). • Student uses evidence to argue which object has more kinetic energy by describing an observable feature (e.g., variation in motion of the kickball as shown by speed or distance). 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student describes that the motion of the object can vary because the energy transferred to the object can vary (e.g., the kickball can go shorter or farther depending on how much energy is transferred from the human body). • Student uses evidence to argue which object has more kinetic energy by describing multiple observable features (e.g., variation in motion of the kickball as shown by speed or distance, variation in sound at impact).

**6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric**

Rubric 2: Student describes the nervous system pathway that causes their object to move, citing information gathered and synthesized from multiple sources.

- Dimensions Assessed: SEP – Obtaining, Evaluating, and Communicating Information, DCI – LS1.D: Information Processing, CCC – Cause and Effect

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
<p>Student inaccurately describes the nervous system pathway that causes their object to move.</p>	<p>Student partially describes the nervous system pathway that causes their object to move, using information gathered from at least one source.</p>	<p>Student completely describes the nervous system pathway that causes their object to move, using information gathered and synthesized from multiple sources.</p>	<p>Student completely describes the nervous system pathway that causes their object to move, citing information gathered and synthesized from multiple sources.</p>
<p>Look Fors:</p> <ul style="list-style-type: none"> • Student inaccurately describes the nervous system pathway for the movement of their object because of major omissions and/or errors (e.g., student leaves out multiple parts of the nervous system or has many inaccuracies in description and order). 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student partially describes the nervous system pathway for the movement of their object with some minor omissions and/or errors (e.g., student leaves out one of the parts of the nervous system, describes the role of one incorrectly, or mixes up one step in the order of the pathway). • Student may or may not cite sources from Task 2. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student completely describes an accurate nervous system pathway for the movement of their object (e.g., stimulus of kickball coming towards person, sensory neuron in the eye receives stimulus, sends message to the brain, brain decides to kick the ball, sends message down spinal cord, received by motor neuron in the leg, and response is to kick the ball). • Student clearly uses information gathered and synthesized from the sources in Task 2 but does not specifically cite them. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student completely describes an accurate nervous system pathway for the movement of their object (e.g., stimulus of kickball coming towards person, sensory neuron in the eye receives stimulus, sends message to the brain, brain decides to kick the ball, sends message down spinal cord, received by motor neuron in the leg, and response is to kick the ball). • Student cites the sources from Task 2 as the information used.

**6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric**

Rubric 3: Student uses evidence to argue how multiple body subsystems with specific functions interact to make their activity possible.

- Dimensions Assessed: SEP – Engaging in Argument From Evidence, DCI – LS1.A: Structure and Function, CCC – Systems and System Models

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student uses evidence to inaccurately argue how multiple body subsystems with specific functions work to make their activity possible.	Student uses evidence to partially argue how multiple body subsystems with specific functions work to make their activity possible.	Student uses evidence to partially argue how multiple body subsystems with specific functions interact to make their activity possible.	Student uses evidence to completely argue how multiple body subsystems with specific functions interact to make their activity possible.
<p>Look Fors:</p> <ul style="list-style-type: none"> • Student describes the functions of few major body subsystems (See <i>Advanced Look-Fors</i> for full list) without a description of interactions and with major errors. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student describes the functions of at least some of the major body subsystems (See <i>Advanced Look-Fors</i> for full list) or all systems with some minor errors. • However, student describes these body subsystems in isolation rather than explicitly providing evidence for their interactions. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student describes the functions of most, but not all major body subsystems (See <i>Advanced Look-Fors</i> for full list). • For the body subsystems identified, student accurately describes most of the interactions between these body subsystems that make their activity possible (See Task 4 Teacher Version for examples of these interactions). 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student describes the functions of all major body subsystems (Nervous, circulatory, respiratory, digestive, muscular, skeletal). • Student accurately describes all of the interactions between these body subsystems that make their activity possible (See Task 4 Teacher Version for examples of these interactions).

**6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric**

Rubric 4: Student develops a model to describe the specific functions of main cell parts.

- Dimensions Assessed: SEP – Developing and Using Models, DCI – LS1.A: Structure and Function

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
<p>Student develops a model to inaccurately describe the specific functions of main cell parts.</p> <p>OR</p> <p>Student partially describes the specific functions of some cell parts, but no model is present.</p>	<p>Student develops a model to partially or completely describe the specific functions of some main cell parts.</p> <p>OR</p> <p>Student completely describes the specific functions of all cell parts, but no model is present.</p>	<p>Student develops a model to partially describe the specific functions of all main cell parts.</p>	<p>Student develops a model to completely describe the specific functions of all main cell parts.</p>
<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a model that shows and describes the functions of at least some main cell parts but does so with major inaccuracies (See <i>Advanced Look-Fors</i> for accurate descriptions). <p>OR</p> <ul style="list-style-type: none"> • Student describes the functions of some main cell parts with partial accuracy in words, but no model is present. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a model that partially or completely shows and describes the functions of some main cell parts (e.g., mitochondria and nucleus, but not cell membrane). The descriptions present might be completely accurate (See <i>Advanced Look-Fors</i> for accurate descriptions) or may have minor errors or missing details. <p>OR</p> <ul style="list-style-type: none"> • Student accurately describes the functions of all main cell parts in words, but no model is present (See <i>Advanced Look-Fors</i> for accurate descriptions). 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a model that partially shows and describes the functions of the mitochondria, nucleus, and cell membrane. Some detail is missing from at least one of the cell parts or minor errors are present (See <i>Advanced Look-Fors</i> for accurate descriptions). 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a model that accurately shows and describes the functions of the mitochondria, nucleus, and cell membrane (e.g., the mitochondria breaks down food molecules into the kind of energy that can be used by the cell to function; the nucleus has all the instructions for the cell’s functioning and decides what proteins are made by the cell; the cell membrane holds in all cell parts and has door-like openings to allow only certain materials to be let into and out of the cell).

**6th Grade Science Unit 1: Setting Things in Motion
3-Dimensional Individual Project Rubric**

Rubric 5: Student develops a model to describe how the function of the cell depends on relationships among its parts.

- Dimensions Assessed: SEP – Developing and Using Models, CCC – Structure and Function

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
<p>Student develops a model to inaccurately describe how the function of the cell depends on relationships among its parts.</p>	<p>Student develops a model to generally describe how the function of the cell depends on relationships among its parts. OR Student partially or completely describes how the function of the cell depends on relationships among its parts, but no model is present.</p>	<p>Student develops a model to partially describe how the function of the cell depends on relationships among its parts.</p>	<p>Student develops a model to completely describe how the function of the cell depends on relationships among its parts.</p>
<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a diagram that may or may not show all the cell parts, but relationships are either inaccurate or irrelevant. For example, student says that the different cell parts talk to each other in order for them all to work together and make energy. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a diagram that may show all the cell parts, but does not describe any specific relationships between the parts. However, student’s model does make a general statement that each cell part does a specific job that the cell needs and allows it to function as a whole. <p>OR</p> <ul style="list-style-type: none"> • Student uses words to describe at least one specific way that the main cell parts interact to make the cell function (See <i>Advanced Look-Fors</i>). However, no model is present. 	<p>Look-Fors</p> <ul style="list-style-type: none"> • Student draws a diagram that shows at least two cell parts and one specific way that they interact to make the cell function. For example, student draws an arrow between the cell membrane and the mitochondria, including a caption that reads, “The cell membrane lets in the sugar that the mitochondria needs to make energy for the cell.” 	<p>Look Fors:</p> <ul style="list-style-type: none"> • Student draws a diagram that shows all three main cell parts and multiple specific ways that they interact to make the cell function. For example, student draws an arrow between the cell membrane and the mitochondria, including a caption that reads, “The cell membrane lets in the sugar that the mitochondria needs to make energy for the cell.” Student also draws an arrow between the nucleus and the cell membrane, including a caption that reads, “The nucleus has the instructions to create protein products, which is the job of the cell, and these products are released through the cell membrane.”

**6th Grade Science Unit 1: Setting Things in Motion
Project Organizer**



Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

You will be teaching people how their bodies make the movement of objects possible in a specific activity. After each task, you will return to the table below to organize what you learn as you go through the unit. By the end of the five tasks, you will have all this information to use for your culminating project. For each activity, be sure to include answers to **ALL** the questions provided.

<p>Lift-Off Task: Objects in Motion</p>	<p>Brainstorm a list of activities that involve humans putting an object in motion. Circle ones that you are interested in using for your project.</p>
<p>Task 1: Energy in Motion</p>	<p>Your presentation will involve demonstrating an activity and explaining the science behind an object’s motion. <u>As a group</u>, first decide on an activity that puts an object in motion to focus on for your culminating project. Then <u>individually</u>,</p> <ul style="list-style-type: none"> <input type="checkbox"/> Describe how an object moves in your group’s chosen activity. <input type="checkbox"/> 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. <ul style="list-style-type: none"> ○ Cite evidence from your argument or investigations to support your explanation.

**6th Grade Science Unit 1: Setting Things in Motion
Project Organizer**



<p>Task 2: Sense and Respond</p>	<p>Your presentation and brochure will include showing how the body’s nervous system allows it to move objects in your chosen activity.</p> <ul style="list-style-type: none"> <input type="checkbox"/> 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.
<p>Task 3: Interacting Subsystems</p>	<p>In this task, you learned that there are other subsystems of the body at work, besides just the nervous system.</p> <ul style="list-style-type: none"> <input type="checkbox"/> In a paragraph, flowchart, or diagram, explain how different subsystems of the body work together to do your chosen activity.

**6th Grade Science Unit 1: Setting Things in Motion
Project Organizer**

<p>Task 4: Got Cells?</p>	<p>In the last task, you described the different subsystems of the body that are involved in your activity.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Research and identify the types of cells that make up the body systems you identified. <input type="checkbox"/> Why do you think these different types of cells look so different? <input type="checkbox"/> Even though they appear different, why are they all called cells?
<p>Task 5: Parts of a Whole</p>	<p>We know from Task 1 that your activity requires energy to move an object.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Now that you have learned about cells and their parts, describe where this energy comes from. <input type="checkbox"/> Pick one body system involved in your activity and do research to fill out the flowchart below. This will show how energy from your body is able to move your object! <div style="text-align: center; margin-top: 20px;"> <p>_____ ⇒ _____ ⇒ _____ ⇒</p> <p>Cell Part Type of Cell Type of Tissue</p> <p>_____ ⇒ _____ ⇒ Interacts with Other Body Organ Body System Systems To Make Your Object Move!</p> </div>

6th Grade Science Unit 1: Setting Things in Motion

Lift-Off Task: Objects in Motion

Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

Every day, students make objects move without thinking twice about how it works. They move food from plates to their mouths as they eat. They pull out chairs to sit down in their classrooms. They kick or throw balls around in the schoolyard at recess. In this unit, students will be exploring how their bodies are able to make objects like these move. They will consider how their bodies are able to produce energy and use it in a way that transfers it to objects. To begin this thought process, students start with the actual experience of kicking a kickball. By considering the phenomenon of humans moving a kickball, students can begin to generate questions about how our bodies make objects move. The questions they generate will guide them throughout the unit as they continue to make sense of this phenomenon, so they can apply it to their own choice of physical activity in their culminating project.

Alignment Table

Because the Lift-Off tasks focus on student-generated questions, we do not identify specific Disciplinary Core Ideas or Science and Engineering Practices in this table.

Crosscutting Concepts (*depending upon student-generated questions)

- Cause and Effect
 - Cause and effect relationships may be used to predict phenomena in natural systems.
- Scale, Proportion, and Quantity
 - Phenomena that can be observed at one scale may not be observable at another scale.
- Systems and System Models
 - Systems may interact with other systems; they may have sub-systems and be a part of a larger complex system.
- Energy and Matter
 - Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
- Structure and Function
 - Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Equity and Groupwork

- Share and listen to broad and diverse student contributions.
- Make connections between each other's ideas.
- Work together to co-construct a concept map.

Language

- Use connector words to link ideas.
- Generate and write questions about the phenomenon.
- Organize key questions in a concept map.

Learning Goals

This learning task introduces students to the phenomenon of humans kicking a kickball and begins generating questions that will guide them through the unit. More specifically, the purpose is to:

6th Grade Science Unit 1: Setting Things in Motion**Lift-Off Task: Objects in Motion**

- Individually generate a list of questions about humans kicking a kickball, using observations from the outdoor activity.
- Make connections between related questions.
- Generate possible answers to questions, using prior knowledge.
- Apply prior experiences of various physical activities to make a list of activities that involve putting an object in motion.

Content Background for Teachers

In this task, students experience the act of kicking a kickball. By making observations from the perspective of the kicker and the outside observer, they will likely generate questions both about the kickball's motion and the inner-workings of the human body that are involved in the kickball's motion. As students gather more knowledge throughout the unit, they will find that the movement of the kickball is made possible because of energy transferred from the human body to the kickball. This energy is manufactured in body cells using the food that they eat and other essential molecules consumed. For more information on scientific concepts related to moving objects and body systems, reference this section in subsequent tasks.

In this task, students create a concept map, which is a graphical tool that helps to organize and represent knowledge and questions, and is a successful academic language instruction tool. In this task, students will likely add only basic terms relating to motion of objects and the human body. As students learn more about the body system processes that allow movement of objects, they will add more complex questions and ideas to this concept map. If your students have not had previous experience making concept maps, please see the instructions in Part B below for strategies on teaching this skill.

Academic Vocabulary

- Energy
- Move/Motion
- Body

*Additional academic vocabulary will vary by class

Time Needed (Based on 45-Minute Periods)

2 Days

- Introduction, Part A and Part B: 1 period
- Class Concept Map, Project Overview, and Project Organizer: 1 period

Materials

- Unit 1, Lift-Off Task Student Version
- Kickball(s)

Part B

- Poster paper and markers
- Post-Its (Optional)

Part C

- Class Poster Paper and markers

6th Grade Science Unit 1: Setting Things in Motion**Lift-Off Task: Objects in Motion**

- *See Instructions below for other optional materials to use for the class concept map

Connecting to the Culminating Project

- Culminating Project Handout
- Project Organizer Handout

Instructions

1. Introduce students to the unit by reading or projecting the Unit Essential Question aloud.
2. To help students think about the essential question, take students outside to take turns kicking a kickball. Ask them to observe what they notice as they kick the kickball and as they watch others kick the kickball. You may want them to record these observations on a separate piece of paper or in a Science Notebook, so they can refer back to them as they generate questions in the next section of this task.

Part A

1. In this section of the task, students will generate questions to help them make sense of the phenomenon—kicking a kickball. Using these self-generated questions throughout the unit will help them get a better understanding of how their bodies make objects move.
2. Have students complete this section individually in their student guide.
 - For students who need more support, encourage them to think back to their experience of kicking a kickball or watching others kick the kickball, and consider any questions they have.
 - Here is a list of some potential questions students might generate: “Why does the kickball move? Why does the ball sometimes go farther? What happens in our bodies to make this possible? Besides muscles in our legs, what else is needed to kick a ball? Where does the energy come from? How does our body decide what action to do?”

Part B:

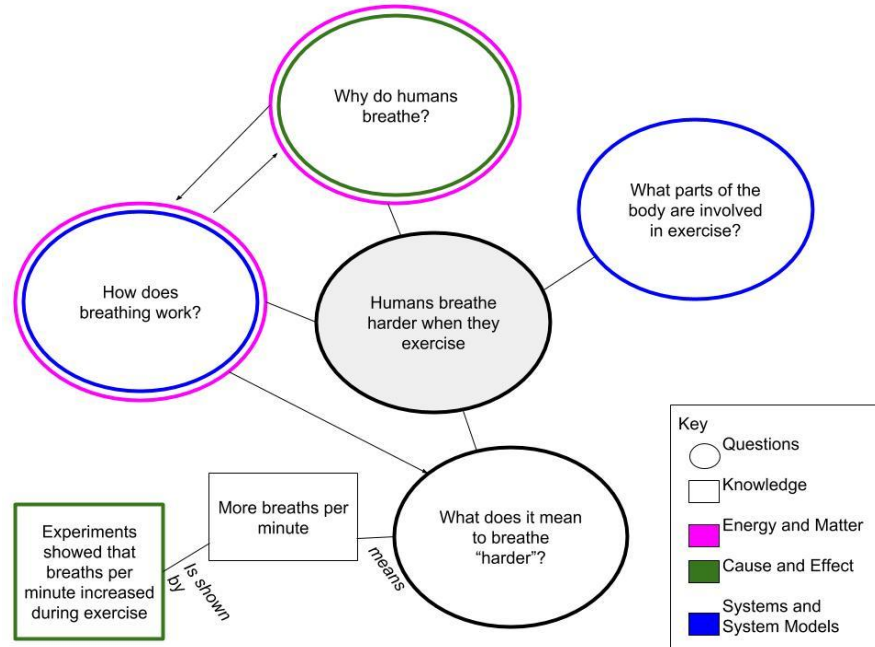
1. In this part of the task, students create a concept map as a group.
 - Remind students to refer to the directions on their student guide to help them make their concept map. First, students should compare each member’s list of questions and record/connect key questions on a piece of poster paper. They will then draft possible answers to the questions, using prior knowledge.
 - Remind students that there are no right or wrong questions or predictions, so students feel encouraged to contribute any and all questions and ideas they think of.
 - Because this is a collaborative task, it is recommended that you remind students of group work norms and assign group roles, such as Resource Manager, Facilitator, Recorder, and Harmonizer (See “How to Use this Curriculum” for more details).
2. Students will post their posters on a wall and then walk around and look at each group’s ideas. One suggestion for gallery walks is for students to interact with the posters in some way. For example, students are required to initial or leave post-its on three questions that they are also excited about on other posters.

6th Grade Science Unit 1: Setting Things in Motion

Lift-Off Task: Objects in Motion

How to Concept Map

For students who have not had a lot of experience making concept maps, we have detailed a strategy below for introducing concept mapping using more familiar content. An example is also provided, but this will vary depending on what your students come up with as you make your own model.



1. Write the phenomenon in the middle of the poster, in this case “Humans breathe harder when they exercise.”
2. Ask students to share questions they might ask to make sense of this phenomenon and make a list of these questions on the board.
3. Model the process of reviewing the list and finding similarities amongst the questions.
 - Place these key questions on the concept map poster, modeling how to put similar questions near each other on the poster. Circle these to signify that these are questions, not content knowledge.
4. Ask students to look at the key questions and see if any of the questions are connected: Would answering one question lead to one of the other questions? Model making these connections by drawing arrows between the circles.
5. In this Lift-Off task, students will only be drafting possible answers to the questions, not actually gathering and recording learned concepts. However, throughout the unit, they will be adding content they have learned. Model this by recording a student’s prior knowledge to one of the questions, using boxes to signify that these are pieces of content knowledge rather than questions.
 - Use connector words to identify the relationships between the content boxes (See image above for an example).
6. Optional: To emphasize crosscutting concepts using a concept map, make a key of different colors for the crosscutting concepts emphasized in this unit. Identify questions that clearly show evidence of the different crosscutting concepts and circle them with the corresponding colors. Explain to students how you made that choice by pointing out the language that hints at that crosscutting concept. *Note: not all boxes and circles will necessarily have a crosscutting concept.

6th Grade Science Unit 1: Setting Things in Motion**Lift-Off Task: Objects in Motion****Part C**

1. Construct a whole-class concept map that begins to help students make sense of the phenomenon of humans kicking a kickball.
 - Start with the phenomenon in the middle.
 - Then ask students to share out the questions that were most common across all the posters in the classroom. As you record questions on the poster, organize them based on connections you see. Draw circles around each question (as you add to the concept map throughout the unit, you'll also be adding concepts learned, which can be written in boxes to distinguish them from the questions).
 - Ask students to identify any connections they see between the questions and record these as lines between the questions.
 - Recommended: Give pairs of students think time to come up with 1-2 connections to add to the class concept map and call on pairs using equity sticks. This encourages more equitable participation in this class-wide activity.
 - The purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content but will also help their oral and written language development.
 - This whole class concept map will be revisited at the end of each task, asking students questions like: Are there any new questions you have about the phenomenon? Are there any connections you want to add or change? What is your reason for that addition/revision? Are there more connections we can make between the questions/ideas already on the map? Do you want to add any new ideas/concepts to the map?
2. Because this concept map will be added to and revised throughout the unit, here are some practical options for implementation.
 - If you have access to white board paper, we encourage you to use these for class posters since it will allow you and your students to make revisions throughout the unit.
 - Another option is to use smaller pieces of paper for each class and project using a document camera; this will save space as opposed to doing large class posters.
 - We highly recommend students keep their own version of this concept map in their notebooks, adding questions and concepts as they go through the unit.
3. Once the draft concept map is complete, introduce students to the crosscutting concepts for this unit. We recommend posting posters of each crosscutting concept in your classroom (See beginning of teacher guide for templates).
 - The crosscutting concepts for this unit are: Cause and Effect; Scale, Proportion, and Quantity; Systems and System Models; Energy and Matter; and Structure and Function. Assign a color for each crosscutting concept that can be used throughout the unit.
 - Have students analyze the class concept map for as many examples of the crosscutting concepts as they can find. Depending on the questions they have, they may be able to find an example of each of the crosscutting concepts or perhaps just some.

6th Grade Science Unit 1: Setting Things in Motion**Lift-Off Task: Objects in Motion**

- We recommend modeling this process by picking a question, identifying the crosscutting concept, and tracing the circle in the corresponding color. Explain the key words that helped you identify the crosscutting concept in this question. Some identifying words that students might look for are:
 - **Cause and Effect:** These could be phrases such as, “that results in,” “that causes,” “that explains why,” “is due to,” etc.
 - **Scale, Proportion, and Quantity:** These could be phrases such as, “is proportional to”, “compared to”, “has a ratio of”, “is bigger/smaller than”, “is longer/shorter than”, etc.
 - **Systems and Systems Models:** These could be phrases such as, “is a part of” “connects to,” “interacts with,” “is made up of,” “works together with,” etc.
 - **Energy and Matter:** These could be phrases such as, “energy is transferred/flows,” “is conserved,” “is important for,” “is needed,” etc.
 - **Structure and Function:** These could be phrases such as, “its shape affects its function by,” “structure causes it to,” “functions this way because of,” etc.

Connecting to the Culminating Project

1. Hand out the Culminating Project Task Card and read the Challenge and Group Project Criteria for Success aloud as a class.
 - Take questions for clarification.
 - Optional: You may want to explain the different format options available for their group project (e.g., live presentation with props and posters, video using basic recording of presentation, whiteboard video using Sparkol VideoScribe, video using Powtoons, etc.)
2. Pass out their Project Organizer and explain that they will complete a section of this after each task in class. Students should independently complete the Lift-Off Task section of the Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
 - Students have been tasked to teach people how their bodies make the movement of objects possible in a specific activity. The student prompt is as follows: Brainstorm a list of activities that involve humans putting an object in motion. Circle ones that you are interested in using for your project.

Reflection

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
 - At the beginning of this task, you made a list of all the questions you have about humans kicking a kickball. Look back at your list: after learning from your peers, how can you add to your list? What kinds of things did you initially leave out? Use the class concept map to help you.
 - In this unit, we will be focusing on five crosscutting concepts: **Cause and Effect:** Cause and effect relationships may be used to predict phenomena; **Scale, Proportion, and Quantity:** Phenomena that can be observed at one scale may not be observable at another scale; **Systems and System Models:** Systems may interact with other systems and may have sub-systems; **Energy and Matter:** Energy may take different forms; and **Structure and Function:** Relationships between parts can be analyzed to determine how systems function. Looking at your class concept map, give one example of how a crosscutting concept came up in today’s task.

6th Grade Science Unit 1: Setting Things in Motion**Lift-Off Task: Objects in Motion**

-
- Now that you understand what project you'll be working on over the course of this unit, what else do you need to know? What additional questions do you have?
2. There are no right answers but encourage students to look back at their initial lists and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their questions and ideas based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and the gathering of knowledge and skills for their final project.

6th Grade Science Unit 1: Setting Things in Motion

Task 1: Energy in Motion



Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

In the Lift-Off task, students explored an example of their bodies putting an object in motion by kicking a kickball. Before students delve into how the body is involved in this action, we first want them to understand the science behind the motion itself. In this task, students explore how the kinetic energy of an object changes when energy is transferred or transformed to or from the object. Through investigations, they will learn that they are able to identify these changes in kinetic energy by noticing observable features, such as motion, temperature, or sound. They are even able to predict an object’s kinetic energy by making observations of its potential energy. By the end of this task, students will be able to use scientific vocabulary to construct an argument about what is happening in their investigations in terms of energy. This will help them explain what would be needed to change the motion of the object in their chosen activity for their culminating project.

Alignment Table

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]</p>	<p>Engaging in Argument From Evidence</p> <ul style="list-style-type: none"> Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. 	<p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> When the motion energy of an object changes, there is inevitably some other change in energy at the same time. 	<p>Energy and Matter</p> <ul style="list-style-type: none"> Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
<p>Supplementary Science and Engineering Practices</p> <ul style="list-style-type: none"> Planning and Carrying Out Investigations <ul style="list-style-type: none"> Conduct an investigation [...] to produce data to serve as the basis for evidence that meet the goals of the investigation. 			
<p>Equity and Groupwork</p> <ul style="list-style-type: none"> Discuss and compare observations with partners and group members. Participate in group roles to conduct an investigation and gather data. 			
<p>Language</p> <ul style="list-style-type: none"> Follow a lab procedure. 			

6th Grade Science Unit 1: Setting Things in Motion

Task 1: Energy in Motion

- Read and annotate an article.
- Critique and correct a claim (optional).
- Construct a written argument, using scientific vocabulary and experimental evidence.

Learning Goals

This learning task asks students to investigate collisions and explain them in terms of kinetic energy changes and energy transfer. More specifically, the purpose is to:

- Engage prior experience to show how changes in kinetic energy can be associated with changes in observable features, like temperature.
- Explore another investigation of kinetic energy transfer with a focus on the relationship to potential energy.
- Explain how energy is involved in both the *Engage* and *Explore* investigations.
- Use knowledge of kinetic energy and observable features to explain a real-life phenomenon.
- Apply knowledge of kinetic energy and energy transfer to the motion of the object in their chosen activity.

Content Background for Teachers

In this task, students explore the concept of energy to understand why objects move and behave as they do. To move an object, a force is required. When a force is applied to an object, this causes 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 kind of motion energy is called kinetic energy. Kinetic energy can be transferred between objects, like when a bat collides with a baseball. Kinetic energy can also be transformed into other kinds of energy, like when car brakes heat up (increased thermal energy) as they slow down a wheel (decreased kinetic energy). In this task, students will explore examples of both kinetic energy transfer and kinetic energy transformation.

Students will be able to find evidence of kinetic energy changes by looking for some key observable features—change in **motion**, **temperature**, or **sound**. In their investigations, students will identify these features to support the argument that when the kinetic energy of an object changes, energy is either transferred or transformed.

In the *Engage* investigation, for example, students notice that an increase in hand motion (kinetic energy) corresponds with an increase in temperature (thermal energy). This is an example of energy transformation.

In the *Explore* investigation, students add another element to their understanding of energy—potential energy. Students observe that if they put the ball at a higher position on the ramp, it will knock over more pennies in the stack at the bottom of the ramp. When the ball is placed in the higher position, it has more potential energy because of gravity, which can then be converted into more kinetic energy once the ball is released. Thus, upon collision, this ball will transfer more kinetic energy to the pennies and knock more over. This is an example of energy transfer.

6th Grade Science Unit 1: Setting Things in Motion**Task 1: Energy in Motion****Academic Vocabulary**

- Energy
- Force
- Motion
- Speed
- Kinetic Energy
- Transfer
- Transform
- Temperature
- Sound
- Potential Energy

Time Needed (Based on 45-Minute Periods)

3.5 Days

- Engage: 0.5 period
- Explore: 0.5 period
- Explain: 1 period
- Elaborate: 0.5 period
- Evaluate and Reflection: 1 period

Materials

- Unit 1, Task 1 Student Version

Explore (Per group)

- Books or other items that can be stacked
- Ball/Marble
- Pipe insulation, cut open to make a track
- 20 pennies

Evaluate

- Project Organizer Handout

Instructions**Engage**

1. Introduce Task 1: In the Lift-Off task, you explored an example of our bodies putting an object in motion. Think about what you were still wondering about at the end of the last task (look back if you need to). What questions do you still have?
 - Before you pass out their student guide, give students time to reflect individually or with a partner about the questions they recorded at the end of the last task. Share a few of these out as a class, using facilitating questions to guide students toward questions that relate to this task.
2. Transition to Task 1: But what influences the motion of an object, like a kickball? Before we delve into how our bodies are involved, today we will explore the science behind the actual motion of objects.
 - Now pass out their Task 1 student guide.

6th Grade Science Unit 1: Setting Things in Motion

Task 1: Energy in Motion

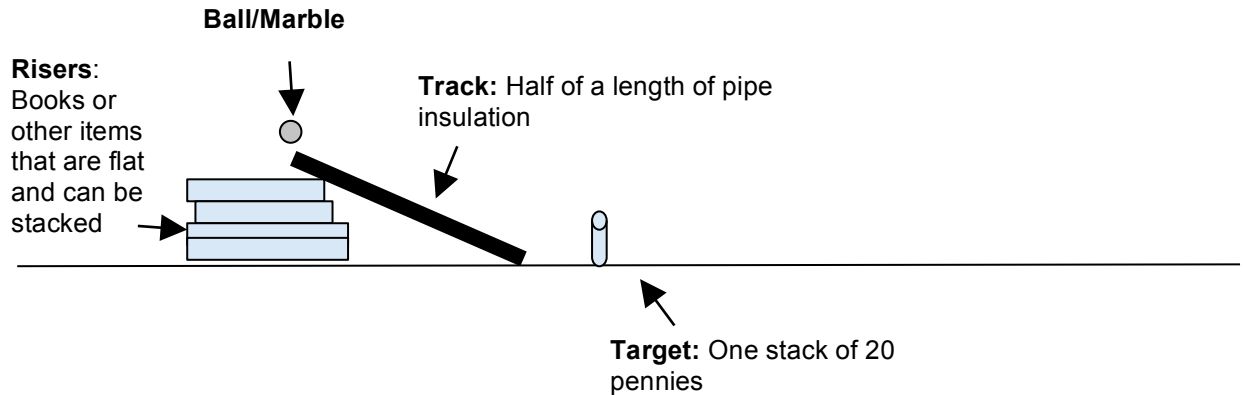
3. Students begin this task by investigating a simple action that they have likely done before—rubbing their hands together. Following the directions in their student guide, students will rub their hands together slowly and then quickly, making observations of sensations at the different speeds and thinking about why the observations are different.
 - All students should conduct the investigation, but they can discuss their observations and comparisons in pairs before recording in their student guide.
 - Share out a few comparisons and hypotheses that students come up with. There are no right answers. Most students will notice that rubbing their hands faster creates more heat, which is exactly the observable feature we hope they notice. Hypotheses will vary, but many will likely mention friction or some other kind of energy transfer as the reason for this temperature difference.

Explore

1. In the *Engage* investigation, students saw that a change in motion was associated with a change in temperature. This set the stage for them to begin to understand the observable features (e.g., motion, sound, temperature) associated with changes in kinetic energy. In this activity, they will continue to build upon this knowledge by investigating how changing a ball's position changes the amount of kinetic energy it has, as evidenced by the amount of pennies it knocks over.
 - This activity gives students practice at the supplementary SEP of **Planning and Carrying Out Investigations** as they conduct investigations to produce data that can serve as evidence for changes in kinetic energy. Students are also implicitly emphasizing the crosscutting concept of **Energy and Matter** as they experience changes in potential and kinetic energy in this investigation.
2. Introduce the investigation by reading aloud and/or projecting the experimental question: 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?
 - Have students individually make a prediction to this question, using the sentence frame in their student guide. You may wish to have them discuss the reasoning behind their prediction with a partner.
3. Distribute the investigation materials outlined in the Materials List above and review the experimental set-up shown in their student guide. Then assign roles to each group. You may use whatever roles you prefer. We recommend the use of the Facilitator, Materials Manager, Harmonizer, and Recorder.
 - Ask the Facilitator to read the directions and to make sure everyone understands the task.
 - Ask the Materials Manager to gather the materials needed to complete the task.
 - Ask the Harmonizer to make sure that everyone contributes their ideas and that everyone's voice is heard.
 - Ask the Recorder to make sure the group is recording their data in their Student Guide.

6th Grade Science Unit 1: Setting Things in Motion

Task 1: Energy in Motion



4. Student groups release a marble from two different heights on the ramp. They should record the amount of pennies knocked over each time.
 - Optional: students may try more height variations than just top of ramp and middle of ramp.
5. Once all groups have completed the investigation, debrief their data in pairs. Students should find that placing the ball higher results in more pennies knocked down. Encourage them to hypothesize why that might be. Use facilitating questions to guide students toward the idea that the higher-positioned ball must have had more energy to allow it to knock over more pennies.
 - We encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).

Explain

1. Thus far, students have seen examples of changes in kinetic energy during energy transfers. However, they have not had the scientific vocabulary to fully understand and explain what they observe. In this *Explain*, students will read an article about energy that provides students with the vocabulary they need to construct an argument about the energy involved in their investigations.
2. First have students individually read and annotate the article about energy in their student guides.
 - This article emphasizes the CCC of **Energy and Matter**, as students learn how energy can take different forms (potential, kinetic, thermal, etc.) and have different observable features (temperature, motion, or sound).
 - Optional: To help students process what they have read, have them brainstorm and practice explaining another example of kinetic energy and energy transfer in pairs.
 - Take questions about the article, as needed.
3. Using the scientific vocabulary and concepts they learned from the article, students then individually construct an argument that explains how energy is involved in both the *Engage* and *Explore* investigations.
 - Students should support their argument with data from the investigations as well as scientific reasoning using the following terms: transfer, transform, kinetic energy, potential energy,

6th Grade Science Unit 1: Setting Things in Motion

Task 1: Energy in Motion

motion/move, and temperature. This allows students explicit practice in the SEP of **Engaging in Argument From Evidence**.

- Optional scaffold: Conduct a Critique, Correct, and Clarify language exercise in pairs before students write their own arguments. We recommend using equity sticks to share out a few pair’s critiques as a class before they move on to independently writing an improved claim in their student guides. An example protocol and graphic organizer is provided below:

Critique, Correct, and Clarify: Energy in Motion

Prompt: Construct an argument to explain the role of energy in both the *Engage* and *Explore* investigations. Include scientific terms and data from the investigations.

In pairs:

- Critique:** Analyze the claim below. Identify the error(s) or things that aren’t clear. Share your ideas with a partner.

Kinetic energy is the type of energy involved in both investigations.
- Correct:** Individually write an improved claim in your student guide.
- Clarify:** Describe how and why you corrected the claim.

Optional Sentence Stems to Provide:

Claim	In both investigations,... This is shown by...
What evidence and scientific reasoning do you have to support your claim?	In both investigations,... ...which is the definition of... In the <i>Engage</i> investigation... This led to... ...which we could observe as... ___ energy was transformed into ___ energy. ___ energy was transferred from ___ to ___. This was shown by... In the <i>Explore</i> investigation... When the ball collided with the pennies,...

6th Grade Science Unit 1: Setting Things in Motion

Task 1: Energy in Motion

Sample Explanation

Claim	In both investigations, the kinetic energy of objects changes as energy is transferred between objects or transformed into other kinds of energy. This is shown by changes in observable features, like motion and temperature.
What evidence and scientific reasoning do you have to support your claim?	In both investigations, there is energy in <u>motion</u> , which is the definition of <u>kinetic energy</u> . In the <i>Engage</i> investigation, increasing hand motion led to more kinetic energy being <u>transformed</u> into thermal energy, which we could feel as a greater <u>temperature</u> . In the <i>Explore</i> investigation, placing the ball higher on the ramp gave it more <u>potential energy</u> , which was transformed into more kinetic energy as it moved down the ramp. When this ball collided with the pennies, it had more kinetic energy to <u>transfer</u> to the pennies, causing more pennies to move.

- We recommend students do this task individually as it can be a good option for formative assessment. Collect student work to identify trends in students' ability to use scientific vocabulary and experimental evidence to support an argument about kinetic energy and energy transfer. See "How to Use This Curriculum" for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.

Elaborate

- Now that students understand the relationship between kinetic energy and energy transfer between objects, they are ready to apply it to a real-life scenario.
- Read the scenario aloud as a class: 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. How can you explain this to the driver?
 - Optional: Show a video of this phenomenon so students have a visual context.
- Students then discuss this scenario with a partner and craft a response together in their student guides.
 - Debrief briefly as a class. Students should be able to explain that the wheel spinning at a rapid speed has a lot of kinetic energy. As the wheel moves against the pavement, it creates friction and some of that kinetic energy is transformed into thermal energy, resulting in heat and smoke.
 - Again, we encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See "How To Use This Curriculum" for more details).
- Return to the whole-class concept map from the Lift-Off Task.
 - In small groups, have students brainstorm new concepts and new connections that they have learned in this task, as well as any new questions that have come up for them. Then have groups share these aloud in a class-wide discussion and add to the class concept map. The use of equity sticks is encouraged for more equitable participation in class-wide discussions (See "How To Use This Curriculum" for more details).
 - Some facilitating questions to ask students are: What new ideas/concepts do you want to add to the map? What connections do you want to add or change? What is your reason for that addition/revision? What connections can we make between the questions/ideas already on the map? What new questions do you have about the phenomenon?

6th Grade Science Unit 1: Setting Things in Motion**Task 1: Energy in Motion**

- Draw circles around each question and boxes around each concept.
- Write connector words to describe connections between the concept boxes.
- For this task, students may begin to connect some of their previous question circles to concept boxes about the following: motion of objects, kinetic energy, and energy transfer or transformation.
- Have students analyze the additions to the class concept map for as many examples of this task’s crosscutting concept as they can find. Once a student has identified the crosscutting concept, you can trace the circle in the corresponding color (decided on in the Lift-Off task). We recommend asking students to share key words that helped them identify the crosscutting concept for that concept or question. Some identifying words students might look for are:
 - **Energy and Matter:** These could be phrases such as, “energy is transferred/flows,” “is conserved,” “is important for,” “is needed,” etc.
- Once again, the purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content, but will also help their oral and written language development.

Evaluate: Connecting to the Culminating Project

1. Usually, we recommend that students independently complete their project organizer. However, at this point, it is important that the group make a decision about what activity they want to focus on for their culminating project. Once this is decided, students independently fill out the Task 1 section of the Unit 1 Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
2. Students have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Their prompt is as follows: 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

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
 - At the beginning of this task, you were asked to make observations when you rubbed your hands together. This experiment showed one type of observable feature associated with kinetic energy. Based on what you learned throughout the task, what are all the different observable features associated with kinetic energy?
 - In this task, we focused on the crosscutting concepts of **Energy and Matter**: Energy may take different forms. Where did you see examples of **Energy and Matter** in this task?
 - Now that you have learned more about the science of moving objects, what questions do you still

6th Grade Science Unit 1: Setting Things in Motion**Task 1: Energy in Motion**

have?

2. There are no right answers, but encourage students to look back at their student guides and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their ideas and questions based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and gathering knowledge and skills for their final projects.

Assessment

1. You may collect students' Project Organizer and assess using:
 - *Criteria of your choice.* We recommend using the 3-Dimensional Assessment matrix at the beginning of this document to inform your criteria.
 - This can be a formative tool to periodically look for trends in student understanding after the completion of a task. You can then use this formative data to inform any re-teaching as necessary.
2. You may also give students time to make revisions with one of the two options:
 - Students may make changes to their Project Organizer according to your comments OR
 - Ask students to exchange Project Organizers with a partner and give partners 5 minutes to give written feedback. Then allow students time to make changes to their work according to the feedback.

6th Grade Science Unit 1: Setting Things in Motion

Task 2: Sense and Respond



Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

In Task 1, students explored the energy involved in moving objects. Here, they transition away from the physics concepts involved to think about how their bodies are able to move objects. To begin to make this connection between their bodies and moving objects, students first explore the nervous system—specifically the pathway signals take in order for the body to sense and respond to its environment in the kinds of activities they are focusing on for their culminating projects. After engaging prior knowledge about the nervous system through a kinesthetic activity, students explore a variety of different sources to gather and synthesize information on nervous system pathways. Equipped with this new knowledge, students reassess the activity from the *Engage* and try to explain how the nervous system was working as they did that activity. By the end of this task, students will have a variety of new scientific terminology to describe the neural response in a reflex arc as well as the activity they chose for their culminating project.

Alignment Table

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. <i>[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]</i></p>	<p>Obtaining, Evaluating, and Communicating Information</p> <ul style="list-style-type: none"> Gather, read, and synthesize information from multiple appropriate sources. 	<p>LS1.D: Information Processing</p> <ul style="list-style-type: none"> Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural systems.
<p>Supplementary Science and Engineering Practices</p> <ul style="list-style-type: none"> Developing and Using Models <ul style="list-style-type: none"> Develop and/or use a model to predict and/or describe phenomena. 			
<p>Equity and Groupwork</p> <ul style="list-style-type: none"> Discuss information gathered from different sources. Participate in roles in a nervous system simulation. Engage in kinesthetic activities with a partner. 			
<p>Language</p> <ul style="list-style-type: none"> Follow written procedures. Read and apply definition cards to a visual diagram. Extract and organize information from a video. Use sequence language and new scientific terminology to develop a model of a process. 			

6th Grade Science Unit 1: Setting Things in Motion**Task 2: Sense and Respond****Learning Goals**

This learning task asks students to gather and synthesize information that the body responds to stimuli by following a neural pathway. More specifically, the purpose is to:

- Engage prior knowledge of nervous system pathways through a kinesthetic activity called “Catch the Ruler”.
- Explore the nervous system by obtaining and synthesizing information from a variety of sources.
- Explain the neural response in the “Catch the Ruler” activity in the form of a flowchart.
- Use knowledge of nervous system pathways to explain what component is missing in a reflex arc.
- Apply knowledge of nervous system pathways to the activity chosen for the culminating project.

Content Background for Teachers

In this task, students are introduced to the nervous system and the role it plays in moving objects in different activities. To move objects, neurons (nerve cells) in the nervous system need to work together to send messages between the brain and the body.

The nervous system consists of two major systems—the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS is made up of the brain and spinal cord and is responsible for processing information. The PNS is made up of sensory neurons, connected to sense organs (skin, nose, eyes, etc.) and motor neurons, connected to effector organs (glands and muscles). Communication between these two systems is essential to allow the body to sense stimuli from the environment, process the signal, and respond appropriately.

In this task, students are focusing on these components of the nervous system within context—in the pathway signals take in the nervous system. To sense and respond to the environment, a stimulus is first received by a sensory neuron in a sense organ. The sensory neuron then relays this message to the brain and/or spinal cord where it is processed. In the brain, this message can be stored as a memory and/or it can inform a response. In a response, the message will be sent from the brain to the spinal cord and out to a motor neuron, which is connected to an effector cell. This effector cell will carry out the response.

Students will play this out with a few different examples. In the “Catch the Ruler” game, the stimulus is the sight of the ruler falling. A sensory neuron in the eye receives this message, which is relayed to the brain and the decision is made to catch the ruler. This message is then sent out through the spinal cord to a motor neuron attached to a muscle cell in the hand, causing the fingers to close.

In the *Explore* nervous system simulation, the pathway is slightly different because of where the sensory neuron is located. In this case, a runner must feel the touch of their teammates hand to begin running. A sensory neuron in the hand receives this message, which is relayed to the spinal cord and up to the brain where the decision is made to catch the ruler. This message is then sent out again through the spinal cord to motor neurons attached to muscle cells in the legs, causing the runner’s legs to begin moving. In the “Catch a Ruler” game, the sensory receptor is in the eye, so the signal goes straight to the brain; the sensory receptor in the relay scenario is in the hand, so the signal must first travel up the spinal cord before it reaches the brain. This is an important distinction for students to notice in this task.

6th Grade Science Unit 1: Setting Things in Motion**Task 2: Sense and Respond**

Understanding this difference in pathway will also help prepare students for the *Elaborate* scenario—a reflex arc. In a reflex arc, the message skips the brain and goes straight from sensory neuron to spinal cord to motor neuron. This is why you are able to pull your hand away so quickly when you touch a hot surface. For more information on any of these topics, please see the resources provided in the *Explore* section.

Academic Vocabulary

- Nervous System
- Stimulus
- Response
- Sensory Neuron
- Motor Neuron
- Brain
- Spinal Cord
- Central Nervous System
- Peripheral Nervous System
- Pathway

Time Needed (Based on 45-Minute Periods)

4.5 Days

- Engage: 0.5 period
- Explore: 1 period
- Explain: 1 period
- Elaborate: 1 period
- Evaluate and Reflection: 1 period

Materials

- Unit 1, Task 2 Student Version

Engage

- Ruler (per pair)

Explore

- Nervous System Definition Cards and Scissors (per person)
- Nervous System Video and Simulation Instructions (per group)
- Computers (per group) or Projector/Speakers (per class)
- Optional: Role Cards for Nervous System Simulation

Elaborate

- Optional: Reflex Hammer (Per Pair)

Evaluate

- Project Organizer Handout

6th Grade Science Unit 1: Setting Things in Motion

Task 2: Sense and Respond

Instructions**Engage**

1. Introduce Task 2: In Task 1, you explored the energy involved in moving different objects, like a kickball. Think about what you were still wondering about at the end of the last task (look back if you need to). What questions do you still have?
 - Before you pass out their student guide, give students time to reflect individually or with a partner about the questions they recorded at the end of the last task. Share a few of these out as a class, using facilitating questions to guide students toward questions that relate to this task.
2. Transition to Task 2: But how are you able to kick a kickball? How does your body move objects in these specific activities?
 - Now pass out their Task 2 student guide.
3. Students begin this task by experiencing how they can sense and respond to their environment through a simple game—“Catch the Ruler”. Frame the game as a challenge: the goal is to catch the ruler with less than 7 cm left at the bottom. You may wish to offer a prize for any student who is able to do it (keeping in mind that catching a ruler with less than 7 cm at the bottom is impossible).
 - Pass out a ruler to each pair of students and have them follow the procedure in their student guides. We recommend modeling the process before students do it in pairs.
 - After both partners have practiced the game, have them debrief the questions on their student guide in partners before debriefing as a class.
 - There are no right answers for the first question, but students should observe that none of them were able to catch the ruler with less than 7 cm left at the bottom of the ruler. Students might come up with hypotheses like, “there is not enough time for us (e.g., our brains to process).” The second question is intended to elicit any prior knowledge students have on the nervous system, so responses will vary.
 - We encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).

Explore

1. To help students understand what happened in the “Catch the Ruler” game, they first need to gather and synthesize information about the nervous system. In groups, students will analyze resources in three different modalities (words and visuals, video, and simulation). To synthesize information, students will take guided notes in the graphic organizer provided in their student guide.
 - This activity gives students practice at the SEP of **Obtaining, Evaluating, and Communicating Information** as they gather, read, and synthesize information from multiple appropriate sources.
 - Because of the style of notetaking, students are also practicing the supplementary SEP of **Developing and Using Models** as they construct annotated diagrams to describe a nervous system pathway.
2. We recommend providing the *Nervous System Definition Cards* to each student so that they can manipulate them as they want in this activity and can keep them for reference.

6th Grade Science Unit 1: Setting Things in Motion**Task 2: Sense and Respond**

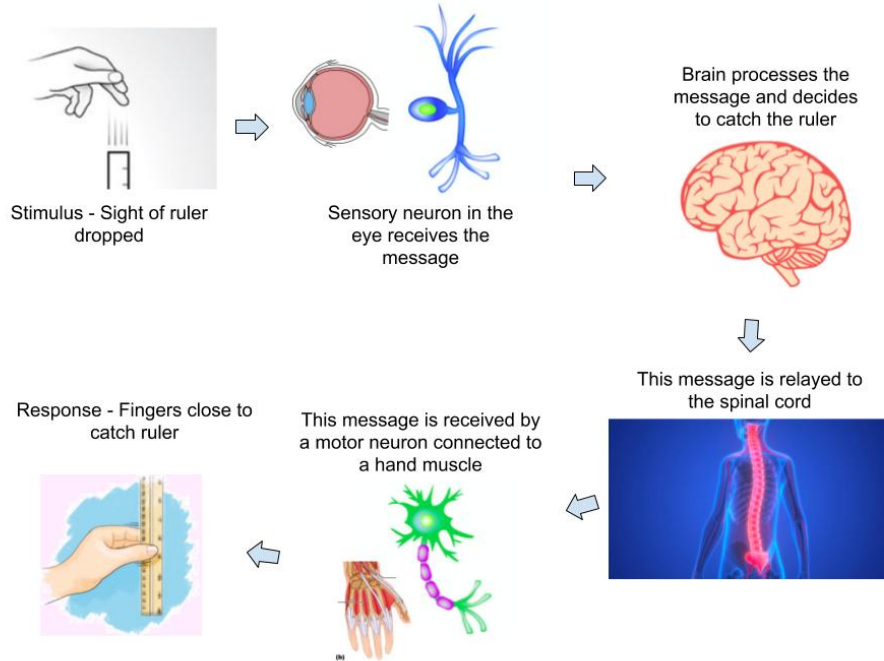
- If you decide to guide this activity as a whole class, you can show the video and give instructions for the simulation as a class.
 - If you run this activity more independently in groups, distribute computers and handouts, and assign roles to each group. You may use whatever roles you prefer. We recommend the use of the Facilitator, Materials Manager, Harmonizer, and Recorder.
 - i. Ask the Facilitator to read the directions and to make sure everyone understands the task.
 - ii. Ask the Materials Manager to gather the materials needed to complete the task.
 - iii. Ask the Harmonizer to make sure that everyone contributes their ideas and that everyone's voice is heard.
 - iv. Ask the Recorder to make sure the group is recording their notes in their Student Guide.
3. For the relay race simulation, you may want to provide groups with role cards so it is clear what role they are playing: “sensory neuron”, “motor neuron”, “spinal cord”, and “brain”.
- We recommend giving groups an opportunity to discuss which component of the nervous system they will start with. Once a group is ready, they can raise their hand to request a “stimulus”.
 - Your role as the teacher will be to act as the “stimulus” by tapping the group member's hand that represents the “sensory neuron”. Each group should indicate which group member you should start with; if they don't indicate the “sensory neuron”, ask a facilitating question and give them more time to discuss before returning to their group.
 - Observe the way students are passing along the neural impulse, asking more facilitating questions to guide them as necessary.
 - The order should be: Stimulus (teacher) > sensory neuron > spinal cord > brain > spinal cord > motor neuron (leads to running response).
 - This activity is a good option for formative assessment. Observe student groups to identify trends in students' ability to accurately demonstrate a neural pathway. See “How to Use This Curriculum” for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.
 - Have one or two groups demonstrate and narrate their neural pathway to the entire class as a class debrief.

Explain

1. Now that students have an understanding of the nervous system, they are able to return to the “Catch a Ruler” game and better explain what is happening. In this portion of the task, students individually draw a flowchart of the process that allowed them to catch the ruler and use this flowchart to explain why no one was able to catch the ruler with less than 7 cm remaining.
2. As students draw their flowchart, encourage them to reference the *Nervous System Definition Cards* to give them an idea of what to include. They should also refer back to their graphic organizer from the *Explore* for additional information. Below is a sample model:

6th Grade Science Unit 1: Setting Things in Motion

Task 2: Sense and Respond



3. The second question asks students to use their new knowledge to explain why no one was able to catch the ruler quickly enough to have less than 7 cm at the bottom.
 - a. This helps students emphasize the CCC of **Cause and Effect** as students use the cause and effect relationships above to predict why such fast responses are impossible.
 - b. Students should be able to explain that such a fast response is not possible because the body must go through all these steps of the nervous system pathway, which takes time.
4. We recommend students do this task individually as it can be a good option for formative assessment. Collect student work to identify trends in students' ability to show cause and effect relationships in a nervous system pathway and use the relationships to predict why such fast responses are impossible. See "How to Use This Curriculum" for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.

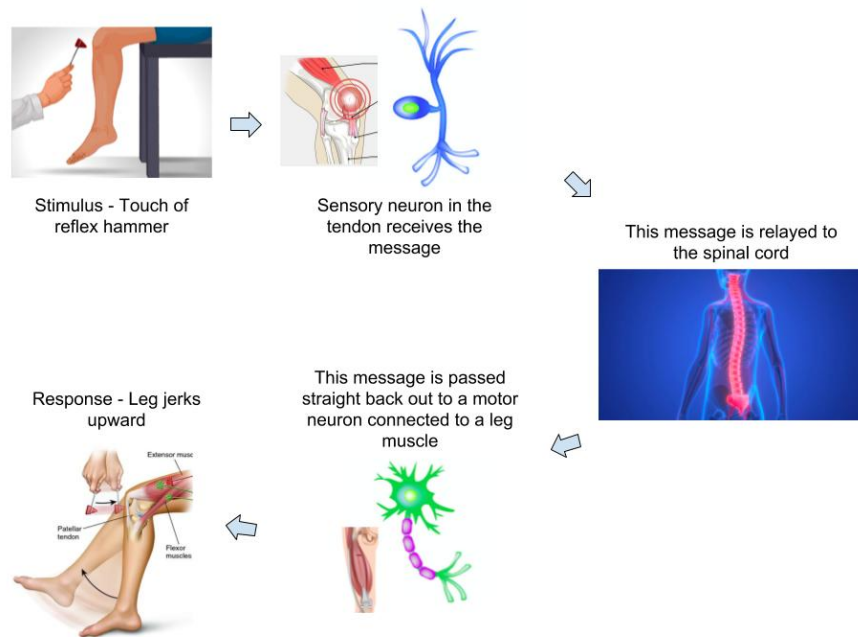
Elaborate

1. For the body to accomplish an action, like catching a ruler, it must sense the object and make a decision to take action. However, sometimes the body takes action without a conscious decision. In this section of the task, students apply what they have learned about typical nervous system pathways to try to make sense of another scenario—a reflex arc.
 - This again allows students to emphasize the CCC of **Cause and Effect** as they use the cause and effect relationships they have identified in previous sections of the task to try to explain neural responses that happen more quickly.

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Task 2: Sense and Respond

2. First have students experience a reflex arc on their own—the patellar reflex or the knee-jerk reflex. Students follow the procedure on their Student Guides in partners, using either the side of their hand or a reflex hammer to stimulate a knee-jerk reaction.
3. After students have completed the demonstration, have them discuss and respond to the questions in their student guide.
 - The knee-jerk reaction is almost instantaneous, so students must consider how such a response can happen so quickly and without thinking about it. They should use logic to infer that if the nervous system pathway in “Catch the Ruler” takes a certain amount of time, then this nervous system pathway must somehow be shorter to be able to happen so quickly. The fact that there is no conscious decision also provides an extra hint that the brain might be the step that is skipped.
 - Below is a sample model of this reflex arc:



4. We recommend debriefing this activity as a class by co-constructing a class reflex arc model after students have completed their own in pairs. This is also a helpful video to review reflex arcs if students still need additional support: <https://www.youtube.com/watch?v=c-dD0N53QRg> (Stop at 1:10).
 - To highlight the slight variety in nervous system pathways, it is also helpful to display models of all three scenarios explored in this task (“Catch the Ruler”, “Relay Race”, “Knee-Jerk Reflex”). Conduct a Think-Pair-Share asking students to notice any differences between the three scenarios and describe reasons for these differences. For example:
 - Catch the Ruler: The pathway goes straight from the sensory neuron to the brain because the sense organ in this case is the eye, which is adjacent to the brain.
 - Relay Race: The pathway goes from the sensory neuron first to the spinal cord and then the brain because the sense organ in this case is the hand.

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- Knee-Jerk Reflex: This pathway skips the brain and goes straight from sensory neuron to spinal cord to motor neuron. This allows for a quick response.
 - Give students an opportunity to think about why our bodies have developed a reflex response (Hint: quickly removing hand from a hot stove).
 - Again, we encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).
5. Return to the whole-class concept map from the Lift-Off Task.
- In small groups, have students brainstorm new concepts and new connections that they have learned in this task, as well as any new questions that have come up for them. Then have groups share these aloud in a class-wide discussion and add to the class concept map. The use of equity sticks is encouraged for more equitable participation in class-wide discussions (See “How To Use This Curriculum” for more details).
 - Some facilitating questions to ask students are: What new ideas/concepts do you want to add to the map? What connections do you want to add or change? What is your reason for that addition/revision? What connections can we make between the questions/ideas already on the map? What new questions do you have about the phenomenon?
 - Draw circles around each question and boxes around each concept.
 - Write connector words to describe connections between the concept boxes.
 - For this task, students may begin to connect some of their previous question circles to concept boxes about the following: the nervous system pathway that allows the body to sense and respond to its environment in different activities.
 - Have students analyze the additions to the class concept map for as many examples of this task’s crosscutting concept as they can find. Once a student has identified the crosscutting concept, you can trace the circle in the corresponding color (decided on in the Lift-Off task). We recommend asking students to share key words that helped them identify the crosscutting concept for that concept or question. Some identifying words students might look for are:
 - **Cause and Effect:** These could be phrases such as, “that results in,” “that causes,” “that explains why,” “is due to,” etc.
 - Once again, the purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content, but will also help their oral and written language development.

Evaluate: Connecting to the Culminating Project

1. Students independently complete the Task 2 section of the Unit 1 Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
2. Students have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Their prompt is as follows: 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.

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Task 2: Sense and Respond

Reflection

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
 - At the beginning of this task, you were asked to describe the process you thought your body was going through to catch a ruler. Look at the flowchart you drew in the *Explain* after learning more about the nervous system. How does your first description in the *Engage* differ from your later description in the *Explain*? What did you learn over the course of this task?
 - In this task, we focused on the crosscutting concepts of **Cause and Effect**: Cause and effect relationships can be used to predict phenomena. Where did you see examples of **Cause and Effect** in this task?
 - Now that you have learned more about nervous system pathways, what questions do you still have?
2. There are no right answers, but encourage students to look back at their student guides and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their ideas and questions based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and gathering knowledge and skills for their final projects.

Assessment

1. You may collect students' Project Organizer and assess using:
 - *Criteria of your choice*. We recommend using the 3-Dimensional Assessment matrix at the beginning of this document to inform your criteria.
 - This can be a formative tool to periodically look for trends in student understanding after the completion of a task. You can then use this formative data to inform any re-teaching as necessary.
2. You may also give students time to make revisions with one of the two options:
 - Students may make changes to their Project Organizer according to your comments OR
 - Ask students to exchange Project Organizers with a partner and give partners 5 minutes to give written feedback. Then allow students time to make changes to their work according to the feedback.

Nervous System Definition Cards

Explore

Stimulus



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

Response



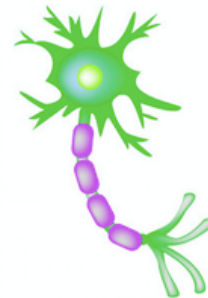
A behavior (e.g., action, thought, or stored memory) that results from a stimulus.

Sensory Neuron



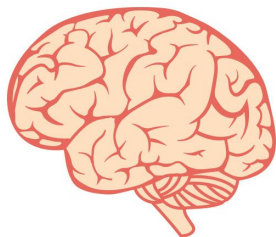
A cell in the nervous system attached to a sense organ (e.g. eye), which receives messages from the body's outside environment and passes it towards the brain or spinal cord.

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.

Spinal Cord



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

Nervous System Video*Explore*

1. Watch sections of the following video: https://www.youtube.com/watch?v=qPix_X-9t7E (Watch 0:00 - 3:30, STOP, Watch 8:35 – 9:25). Pause and replay, as necessary.
 2. Take notes in the table in your student guide.
-

Nervous System Simulation*Explore*

In this activity, you will be simulating what happens in your body when you sense and respond to your environment.

1. Assign roles within your group so that each of you represents one component of the nervous system response:
 - Sensory Neuron (in skin of hand)
 - Motor Neuron (in leg muscle)
 - Spinal Cord
 - Brain
2. 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 team,
 - a. Discuss how this message would move through your nervous system (Hint: keep in mind that a message can sometimes go through the same component twice!)
3. In this scenario, your teacher will act as the stimulus by tapping the hand of the student who represents the first part of the nervous system response. Each member of your group can receive and pass the message by tapping each other's hands. With your team,
 - a. Discuss the order in which you will pass the message between each person, depending on your group roles.
 - b. When you are ready, raise your hand so your teacher can start the nervous system response.
4. Record your process in your student guide and prepare to share out as a group.

6th Grade Science Unit 1: Setting Things in Motion

Task 3: Interacting Subsystems



Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

In Task 2, students learned about how their nervous system is involved in making objects move. In this task, they broaden their understanding of the human body to consider what other subsystems might also be at work. We first activate any prior knowledge students have about body systems. They then investigate a common everyday activity—exercise—to gather evidence that body systems really do work together to do work. Because the *Explore* experiment only shows obvious evidence of two systems (respiratory and circulatory), students also read an article about the six main body systems to learn more about how other systems might be working together behind the scenes. Using this information, students are able to refute the argument that only two body systems work together during exercise. By the end of this task, students will be able to show and describe how all body systems interact to do both exercise and their chosen activity for their culminating project.

Alignment Table

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. <i>[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]</i></p>	<p>Engaging in Argument From Evidence</p> <ul style="list-style-type: none"> Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. 	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. 	<p>Systems and System Models</p> <ul style="list-style-type: none"> Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

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Task 3: Interacting Subsystems

<p>Supplementary Science and Engineering Practices</p> <ul style="list-style-type: none"> • Developing and Using Models <ul style="list-style-type: none"> ○ Develop and/or use a model to predict and/or describe phenomena. • Planning and Carrying Out Investigations <ul style="list-style-type: none"> ○ Conduct an investigation [...] to produce data to serve as the basis for evidence that meet the goals of the investigation.
<p>Equity and Groupwork</p> <ul style="list-style-type: none"> • Discuss and come to consensus to identify body systems used in an activity. • Participate in task-specific roles in an investigation. • Participate in group roles to construct a poster.
<p>Language</p> <ul style="list-style-type: none"> • Follow written procedures. • Read and extract information from an article. • Incorporate information from an article into a written argument and visual model.

Learning Goals

This learning task asks students to use evidence to construct an argument that the body is a system of interacting subsystems. More specifically, the purpose is to:

- Engage prior knowledge of body systems as they relate to specific everyday activities.
- Explore the interaction of body systems by measuring heart rate and respiratory rate during exercise.
- Refute a claim in order to explain that exercise requires the interaction of all body systems.
- Construct a model to show the specific interactions of subsystems in the body.
- Apply knowledge of body systems to describe how they interact in the activity chosen for the culminating project.

Content Background for Teachers

In this task, students are introduced to six main body systems that work together so the whole body can function: circulatory system, respiratory system, digestive system, nervous system, muscular system, and skeletal system. To learn more about these systems and how they interact with each other, please reference the article entitled *Subsystems of the Body* that is provided to students during the *Explain* portion of this task.

Academic Vocabulary

- Subsystem
- Circulatory System
- Respiratory System
- Digestive System
- Nervous System
- Muscular System
- Skeletal System
- Respiratory Rate
- Heart Rate
- Interact

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- Tissue
- Organ

Time Needed (Based on 45-Minute Periods)

4 Days

- Engage: 0.5 period
- Explore: 0.5 period
- Explain: 1 period
- Elaborate: 1 period
- Evaluate and Reflection: 1 period

Materials

- Unit 1, Task 3 Student Version

Engage

- 4 blank pieces of paper (per group)
- Projector and Activity Photos (per class)

Explore

- Timer - phone, watch, stopwatch (per group)

Explain

- Article - *Subsystems of the Body* (per student)

Elaborate (per group)

- Poster Paper
- Markers
- Computers/Tablets to Conduct Research

Evaluate

- Project Organizer Handout

Instructions**Engage**

1. Introduce Task 3: In Task 2, you learned how the nervous system plays a key role in the body's ability to make objects move. Think about what you were still wondering about at the end of the last task (look back if you need to). What questions do you still have?
 - Before you pass out their student guide, give students time to reflect individually or with a partner about the questions they recorded at the end of the last task. Share a few of these out as a class, using facilitating questions to guide students toward questions that relate to this task.
2. Transition to Task 3: But what other subsystems of the body are involved in various actions?
 - Now pass out their Task 3 student guide.
3. Students begin this task with an activity intended to elicit any prior knowledge students have as well as illuminate a possible misconception.

6th Grade Science Unit 1: Setting Things in Motion**Task 3: Interacting Subsystems**

- First, introduce students to the six main subsystems they will be focusing on in this task: circulatory system, nervous system, respiratory system, digestive system, skeletal system, and muscular system. We recommend projecting the image on their Student Guides to review these terms as a class.
4. Hand out 4 pieces of blank paper to each group. The resource card for this task provides pictures of four different familiar activities: reading, running, sleeping, and swimming.
 - Display these pictures one at a time to students.
 - In groups, students will discuss each picture and decide which body systems they think are involved in that activity, recording on a blank piece of paper.
 - Have student groups hold up their pieces of paper at the same time and discuss any discrepancies between the groups. There is no need to reach consensus, but ask a few groups to justify why they included or omitted different subsystems for each activity.
 5. After going through all four activities, have groups discuss the discussion questions in their Student Guide.
 - Debrief these questions as a class. These questions are intended to elicit a common misconception that systems like the muscular system are only involved in “physically active” activities, when in fact they are used for all kinds of activities. As students move throughout the task, this concept will become clearer to them.
 - We encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).

Explore

1. The previous activity elicited student ideas about the subsystems of the body involved in different activities. In this activity, students gather evidence to show that body systems do indeed work together.
 - This *Explore* gives students practice at the supplementary SEP of **Planning and Carrying Out Investigations** as they conduct investigations to gather data that can serve as evidence of interacting body systems.
2. In this investigation, students measure heart rate and respiratory rate at rest and again after exercise.
 - While simple, measuring heart rate and breathing rate can initially be challenging for students, so we recommend demonstrating these processes as a class and allowing students to practice before beginning the investigation. You may also choose to model how to calculate heart rate and respiratory rate so students know how to do this with their own data.
3. Assign roles within each group: Exerciser/Heart Rate Monitor, Respiratory Rate Monitor, Timer, and Data Calculator/Recorder. Make sure every group has a phone, stopwatch, or other device to use as a timer.
 - Student groups will follow the procedure on their Student Guides to conduct the investigation and record their data.
 - Because heart rate and respiratory rate need to be taken in a timely manner after exercise, we recommend having student groups read the procedure in full before beginning their investigation. You may also choose to read the procedure together as a class.

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- After everyone has completed their investigation, briefly share and discuss trends in results as a class. Students should have noticed an increase in both heart rate and respiratory rate after exercise, as well as some other physiological changes (e.g., redness in the face, heat from skin, sweat, muscle fatigue, etc.)

Explain

- While the observations students noticed in the investigation should not be new to students, the ability to explain the mechanisms behind those observations is a new challenge. In this *Explain*, students are presented with another student’s argument that doing exercise requires only the respiratory system and circulatory system to work together. They then construct an argument supporting or refuting this student’s claim.
 - This allows practice of the SEP of **Engaging in Argument From Evidence** as students use evidence from the experiment and additional information from a body systems article to support or refute an argument.
- Distribute the *Subsystems of the Body* article to students and encourage them to annotate or highlight information that they think might be helpful for their argument.
- Below are optional sentence stems you may provide to students as a language scaffold, as well as a sample student response.

Claim:	I disagree/agree with the student’s argument because...
Evidence and Reasoning:	The experiment showed that _____ systems are involved because... I learned from the article that... The article also states that... The _____ system and _____ system are also clearly involved because... Lastly, the _____ system... Thus, _____ subsystems of the body are interacting to do exercise...

Claim:	I disagree with the student’s argument because there are many more subsystems in the human body that must interact to do exercise.
Evidence and Reasoning:	The experiment showed that the respiratory and circulatory systems are involved because heart rate and breathing rate both increased. I learned from the article that these rates increased to bring more oxygen into the body and deliver it more quickly to the cells that need it to make energy. The article also states that cells need nutrients to make energy and this comes from the digestive system. The muscular system and skeletal system are also clearly involved because these are the systems that support and create the movements done while exercising. Lastly, the nervous system is what actually delivers the message to the muscles to move and also adjusts breathing rate during physical activity. Thus, all subsystems of the body are interacting to do exercise, not just the respiratory and circulatory systems.

6th Grade Science Unit 1: Setting Things in Motion

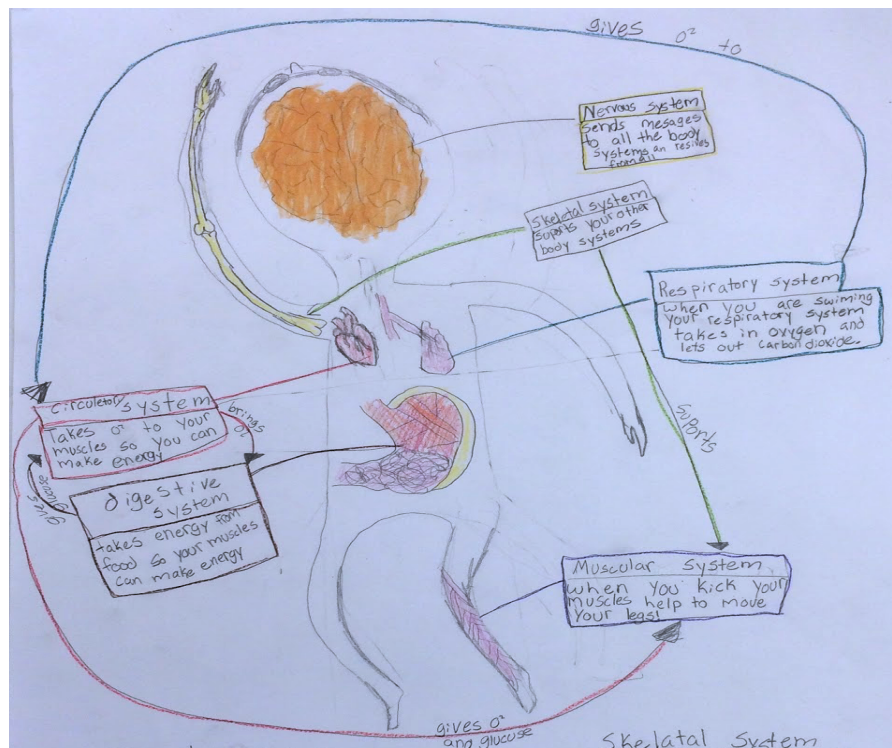
Task 3: Interacting Subsystems

4. We recommend students do this task individually as it can be a good option for formative assessment. Collect student work to assess students' ability to refute an argument and use evidence to describe interaction of body systems. See "How to Use This Curriculum" for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.

Elaborate

- While students have already described the interaction of different body systems in paragraph form, often times it is easier to visualize all the various interactions with a model. In this activity, student groups make a poster model to show how all the subsystems of the body interact during exercise.
 - This emphasizes the CCC of **Systems and System Models** as students develop a model to show interactions between subsystems that contribute to the function of the larger system.
- Assign roles to each group. You may use whatever roles you prefer. We recommend the use of the Facilitator, Materials Manager, Harmonizer, and Reporter.
 - Ask the Facilitator to read the directions and to make sure everyone understands the task.
 - Ask the Materials Manager to gather the materials needed to complete the task.
 - Ask the Harmonizer to make sure that everyone contributes their ideas and that everyone's voice is heard.
 - Ask the Reporter to make sure the group is reporting all the information on the poster.
- To the right is a sample of student work to show the type of model students might create. Notice that students should not only describe the subsystem, they should also specifically show with arrows and captions how they interact.

- We recommend doing a gallery walk after class posters are complete so students can see examples of different groups' models. This provides a good check for understanding, so you can see where students are in their understanding. Students can then go back and revise their own poster models as necessary.



6th Grade Science Unit 1: Setting Things in Motion**Task 3: Interacting Subsystems**

4. Return to the whole-class concept map from the Lift-Off Task.
 - In small groups, have students brainstorm new concepts and new connections that they have learned in this task, as well as any new questions that have come up for them. Then have groups share these aloud in a class-wide discussion and add to the class concept map. The use of equity sticks is encouraged for more equitable participation in class-wide discussions (See “How To Use This Curriculum” for more details).
 - Some facilitating questions to ask students are: What new ideas/concepts do you want to add to the map? What connections do you want to add or change? What is your reason for that addition/revision? What connections can we make between the questions/ideas already on the map? What new questions do you have about the phenomenon?
 - Draw circles around each question and boxes around each concept.
 - Write connector words to describe connections between the concept boxes.
 - For this task, students may begin to connect some of their previous question circles to concept boxes about the following: other subsystems in the body and how they work together.
 - Have students analyze the additions to the class concept map for as many examples of this task’s crosscutting concept as they can find. Once a student has identified the crosscutting concept, you can trace the circle in the corresponding color (decided on in the Lift-Off task). We recommend asking students to share key words that helped them identify the crosscutting concept for that concept or question. Some identifying words students might look for are:
 - **Systems and Systems Models:** These could be phrases such as, “is a part of” “connects to,” “interacts with,” “is made up of,” “works together with,” etc.
 - Once again, the purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content, but will also help their oral and written language development.

Evaluate: Connecting to the Culminating Project

1. Students independently complete the Task 3 section of the Unit 1 Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
2. Students have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Their prompt is as follows: 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.

Reflection

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
 - At the beginning of this task, you were asked to identify which body systems you thought were involved in different activities. Look back at your responses to the questions in the *Engage*. How has your understanding of the body systems involved in various activities changed over the

6th Grade Science Unit 1: Setting Things in Motion**Task 3: Interacting Subsystems**

- course of this task?
- In this task, we focused on the crosscutting concept of **Systems and System Models**: Systems may interact with other systems and may have sub-systems. Where did you see examples of **Systems and System Models** in this task?
 - Now that you have learned more about other subsystems of the body that are needed to do activities, what questions do you still have?
2. There are no right answers, but encourage students to look back at their student guides and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their ideas and questions based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and gathering knowledge and skills for their final projects.

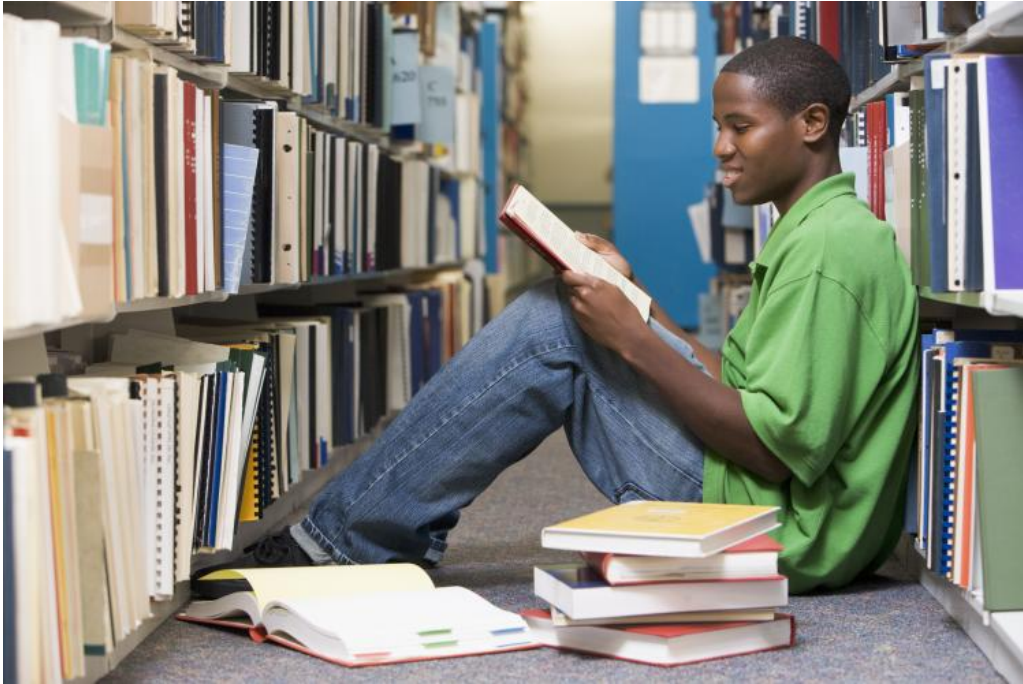
Assessment

1. You may collect students' Project Organizer and assess using:
 - *Criteria of your choice*. We recommend using the 3-Dimensional Assessment matrix at the beginning of this document to inform your criteria.
 - This can be a formative tool to periodically look for trends in student understanding after the completion of a task. You can then use this formative data to inform any re-teaching as necessary.
2. You may also give students time to make revisions with one of the two options:
 - Students may make changes to their Project Organizer according to your comments OR
 - Ask students to exchange Project Organizers with a partner and give partners 5 minutes to give written feedback. Then allow students time to make changes to their work according to the feedback.

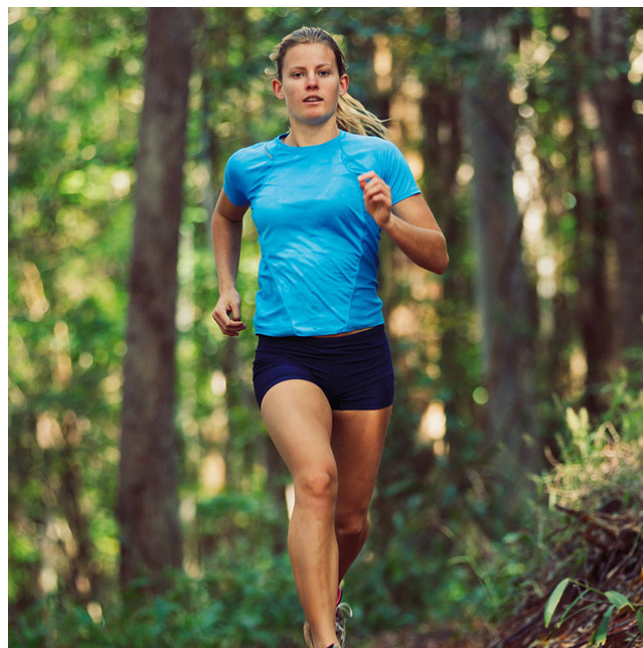
Activity Photos

Engage

Reading



Running



Sleeping



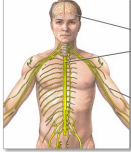
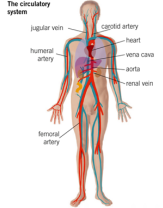
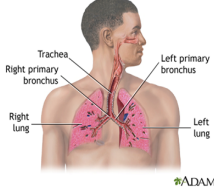
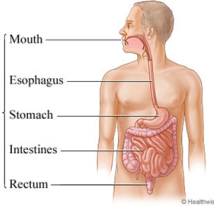


Swimming



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
<p>Nervous</p> 	<ul style="list-style-type: none"> • Nerves • Brain • Spinal Cord 	<p>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.</p>
<p>Circulatory</p> 	<ul style="list-style-type: none"> • Red Blood Cells • Heart • Blood Vessels 	<p>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.</p>
<p>Respiratory</p> 	<ul style="list-style-type: none"> • Lungs • Trachea 	<p>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.</p>
<p>Digestive</p> 	<ul style="list-style-type: none"> • Mouth • Esophagus • Stomach • Intestines 	<p>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 deliver to other cells.</p>
<p>Muscular</p> 	<p>Muscle types:</p> <ul style="list-style-type: none"> • Voluntary • Involuntary • Cardiac 	<p>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.</p>
<p>Skeletal</p> 	<ul style="list-style-type: none"> • Bones • Cartilage 	<p>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.</p>

6th Grade Science Unit 1: Setting Things in Motion

Task 4: Got Cells?

Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

So far in this unit, students have explored the energy involved in moving objects and the different body systems that interact to put objects in motion. However, they still have not completely connected these two concepts—Where do our bodies actually make the energy that we transfer to these objects? Students will explicitly dig into this question in Task 5 as they look at cell parts, but in order to do so, students first need to understand that the human body they have been examining is made up of cells. In this task, students zoom in to look at the human body up close in order to discover that only living things are made up of cells. Throughout the activities, students will explore the crosscutting concept of Scale, Proportion, and Quantity in depth as they compare the colloquial definition of cells that is used to describe macroscopic objects and how this compares to the biological cell that can only be seen with a microscope. By the end of this task, students will be prepared to research the types of cells involved in their activity and explain why they look different, but are all still referred to as cells.

Alignment Table

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]</p>	<p>Planning and Carrying Out Investigations</p> <ul style="list-style-type: none"> Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. 	<p>LS1.A: Structure and Function</p> <p>All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).</p>	<p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Phenomena that can be observed at one scale may not be observable at another scale.
<p>Supplementary Science and Engineering Practices</p> <ul style="list-style-type: none"> Analyzing and Interpreting Data <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings. 			
<p>Equity and Groupwork</p> <ul style="list-style-type: none"> Discuss and come to consensus on a definition for “cell”. Participate in group roles in an investigation and subsequent data analysis. 			
<p>Language</p> <ul style="list-style-type: none"> Use visual observations to construct a definition. Use descriptive language to record observations. Use compare and contrast language to describe similarities and differences in data. Use the Critique, Correct, and Clarify strategy to critique content and language. 			

6th Grade Science Unit 1: Setting Things in Motion**Task 4: Got Cells?****Learning Goals**

This learning task asks students to conduct an investigation to discover that living things are made up of cells. More specifically, the purpose is to:

- Engage prior knowledge of the definition of cells using non-scientific examples.
- Explore microscope images of different specimens.
- Analyze observations of microscope images to identify similarities and differences that imply only living things are made up of cells.
- Critique the claim that a beehive is living because it is made up of wax cells.
- Apply knowledge of cells to research and describe the types of cells involved in the activity chosen for the culminating project.

Content Background for Teachers

In this task, students zoom in on the human body to explore what it is made of on a more microscopic scale. All living organisms on Earth are made up of cells, which is the smallest unit that can be said to be alive. Cells are small compartments that house all the parts necessary to keep an organism alive and functioning successfully.

In the next task, students will go into these specific parts and their functions. However, in this task, the focus is merely for students to find evidence that only living things are made up of cells. This evidence can only be provided with microscope images since cells are too small to be seen with the naked eye.

Living things can consist of one single cell (unicellular), or many different numbers and types of cells (multicellular). Examples of unicellular organisms are bacteria, algae, or fungi. Examples of multicellular organisms are humans, other animals, and plants. *Because of the nature of the culminating project, we focus on multicellular organisms in this task. However, we recommend showing students examples of unicellular organisms, like the ones listed above.*

Academic Vocabulary

- Cell
- Specimen
- Microscope
- Macroscopic
- Microscopic
- Beehive

Time Needed (Based on 45-Minute Periods)

3.5 Days

- Engage: 0.5 period
- Explore: 1 period
- Explain: 0.5 period
- Elaborate: 0.5 period
- Evaluate and Reflection: 1 period

6th Grade Science Unit 1: Setting Things in Motion

Task 4: Got Cells?

Materials

- Unit 1, Task 4 Student Version

Explore

- *Microscope Station Cards* (2-3 per station)

Evaluate

- Tablets or Computers to do research
- Project Organizer Handout

Instructions**Engage**

1. Introduce Task 4: In the last two tasks, you explored all the different body systems that work together when we move objects. Think about what you were still wondering about at the end of the last task (look back if you need to). What questions do you still have?
 - Before you pass out their student guide, give students time to reflect individually or with a partner about the questions they recorded at the end of the last task. Share a few of these out as a class, using facilitating questions to guide students toward questions that relate to this task.
2. Transition to Task 4: But where do our bodies actually make the energy that we transfer to these objects? In this task, we will begin to explore this question by first zooming in to look at these body systems up close.
 - Now pass out their Task 4 student guide.
3. Students begin this task by using their prior knowledge of non-scientific “cells” to co-construct a definition for the word “cell”. By constructing a definition for the word, students are creating their own understanding of structures to look for in their investigation.
 - It is very important to emphasize that these are non-scientific ways people use the word “cell”, which is similar but not the same as the way scientists use the word “cell” in science. This will become particularly important as they examine another colloquial example of cells in the *Elaborate*.
4. Introduce the activity to students by saying: Many of you have likely heard that we are made up of cells, what actually is a cell?
 - First have students record their own answer to the question: what is a cell?
5. Transition to the next section by saying: We often use the word, cell, to describe other everyday things, not just scientific things.
 - Have students analyze the non-scientific examples of cells in their Student Guide and discuss the similarities they see with a partner.
 - Based on these similarities, students will then write a group definition for the word, cell.
6. Share out a few groups’ definitions to come to consensus on a class definition.
 - Students will likely have noticed that in all images, there is a group of connected, repeating components of relatively the same shape. This should inform their definitions.

6th Grade Science Unit 1: Setting Things in Motion**Task 4: Got Cells?**

- We encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).

Explore

1. While the non-scientific images in the *Engage* helped to show students what a cell could look like, those were viewed at a macroscopic scale. To really see if an object is made up of cells in the scientific sense, we need to zoom in using a microscope. This is because cells are too small to be seen with the naked eye.
 - This *Explore* gives students practice at the SEP of **Planning and Carrying Out Investigations** as they investigate microscope images to gather observations that can serve as evidence for what types of specimens are made up of cells.
 - By looking at both macroscopic and microscopic images, this investigation explicitly emphasizes the CCC of **Scale, Proportion, and Quantity**. Students should notice that while cells are not visible with the naked eye (macroscopic), they are visible with a microscope (microscopic). This understanding will help them with the *Elaborate* prompt.
2. We recommend setting this investigation up as a station activity consisting of 7 stations. Place 2-3 of each station card at each station and rotate students between the stations until each group has seen all 7 specimens.
 - As they discuss what they see, students should record their observations in their Student Guide, including initial opinions on whether they think the specimen is made up of cells.
3. Assign roles to each group. You may use whatever roles you prefer. We recommend the use of the Facilitator, Materials Manager, Harmonizer, and Recorder.
 - Ask the Facilitator to read the directions and to make sure everyone understands the task.
 - Ask the Materials Manager to gather the materials needed to complete the task.
 - Ask the Harmonizer to make sure that everyone contributes their ideas and that everyone’s voice is heard.
 - Ask the Recorder to make sure the group is recording all their observations in their Student Guides.

Explain

1. Once students have seen all the specimens, they are able to compare the images to come to conclusions about what types of things are made up of cells.
 - This allows practice of the supplementary SEP of **Analyzing and Interpreting Data** as students compare their observations to determine similarities and differences that might imply categories.
 - Students are referring back to their understanding of **Scale, Proportion, and Quantity** as they consider observations that are apparent at the microscopic scale that are not apparent at the macroscopic scale.
2. As a group, students fill out the graphic organizer in their Student Guides to help them compare and contrast the 7 specimens. A sample is provided below:

6th Grade Science Unit 1: Setting Things in Motion

Task 4: Got Cells?

Grouping 1	Grouping 2
Which images were similar? List the specimens here: <ul style="list-style-type: none"> ○ <i>Human Blood</i> ○ <i>Human Skin</i> ○ <i>Human Bone</i> ○ <i>Moss Leaf</i> ○ <i>Cork Tree Bark</i> 	Which images were different from the majority? List the specimens here: <ul style="list-style-type: none"> ○ <i>Cotton Thread</i> ○ <i>Printed Paper</i>
Describe what these images have in common. <i>All of these images have repeating circular structures that are packed together.</i>	Describe how these images were different from the majority of other images. <i>These images don't have cell-like structures. The printed paper seems to have no common structure. The cotton thread has bundled fibers</i>

3. Based on the groupings they have created, students use their prior knowledge to compare the two lists.
 - Students should notice that specimens in Grouping 1 are all living organisms, whereas the specimens in Grouping 2 are both non-living organisms.
 - This implies that only living things are made up of cells.
 - We highly recommend debriefing the conclusion questions as a class to ensure that everyone has the shared understanding that living things are made up of cells, which can only be viewed with a microscope.

Elaborate

1. The goal of this activity is to solidify the idea that while the colloquial definition of “cell” is similar to the biological definition of “cell”, they are not the same. In other words, the fact that a beehive appears to have cells when looking at it with the naked eye does not mean it is a living thing.
 - This drives home the CCC of **Scale, Proportion, and Quantity** as students realize that the phenomenon of living things being made up of biological cells can only be observed at the microscopic, not macroscopic scale.
2. Introduce the scenario by reading the text from their Student Guide aloud. Students will be using the language strategy known as Critique, Correct, and Clarify to critique the following claim: *Beehives are living things because I can see with my naked eye that they are made up of wax cells.*
 - Students then follow the protocol in their student guide to critique the statement in partners, individually write an improved statement, and then discuss with a partner why they corrected the claim.
 - A possible student sample is provided below:
 - i. Correct: *Even though beehives appear to have cells when viewed with the naked eye, they are not considered living things. This is because when beehives are viewed under a microscope, they are not actually made up of cells.*

6th Grade Science Unit 1: Setting Things in Motion**Task 4: Got Cells?**

- ii. Clarify: *The original statement that beehives are living things is incorrect. Their reasoning is based on looking at a beehive with the naked eye when you really need to look at it with a microscope to figure out if it has cells. This will tell you if it is living or not.*
3. The “Correct” and “Clarify” sections are good options for formative assessment. Collect student work to assess students’ understanding of **Scale, Proportion, and Quantity** within this context of the types of specimen that is made up of cells. See “How to Use This Curriculum” for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.
- We also recommend sharing out a few corrected statements and justifications after partners have discussed so students can share understanding and you can get an idea of where students are with these concepts.
4. Return to the whole-class concept map from the Lift-Off Task.
- In small groups, have students brainstorm new concepts and new connections that they have learned in this task, as well as any new questions that have come up for them. Then have groups share these aloud in a class-wide discussion and add to the class concept map. The use of equity sticks is encouraged for more equitable participation in class-wide discussions (See “How To Use This Curriculum” for more details).
 - Some facilitating questions to ask students are: What new ideas/concepts do you want to add to the map? What connections do you want to add or change? What is your reason for that addition/revision? What connections can we make between the questions/ideas already on the map? What new questions do you have about the phenomenon?
 - Draw circles around each question and boxes around each concept.
 - Write connector words to describe connections between the concept boxes.
 - For this task, students may begin to connect some of their previous question circles to concept boxes about the following: cells.
 - Have students analyze the additions to the class concept map for as many examples of this task’s crosscutting concept as they can find. Once a student has identified the crosscutting concept, you can trace the circle in the corresponding color (decided on in the Lift-Off task). We recommend asking students to share key words that helped them identify the crosscutting concept for that concept or question. Some identifying words students might look for are:
 - **Scale, Proportion, and Quantity:** These could be phrases such as, “is proportional to”, “compared to”, “has a ratio of”, “is bigger/smaller than”, “is longer/shorter than”, “is observed at one scale”, “cannot be observed at another scale”, etc.
 - Once again, the purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content, but will also help their oral and written language development.

Evaluate: Connecting to the Culminating Project

1. Students independently complete the Task 4 section of the Unit 1 Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.

6th Grade Science Unit 1: Setting Things in Motion**Task 4: Got Cells?**

2. Students have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Their prompt is as follows: 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?

Reflection

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
 - At the beginning of this task, you were looked at non-scientific examples of cells. What makes these examples of cells similar to the ones you saw in the rest of the task? What makes them different?
 - In this task, we focused on the crosscutting concept of **Scale, Proportion, and Quantity**: Phenomena that can be observed at one scale may not be observable at another scale. Where did you see examples of **Scale, Proportion, and Quantity** in this task?
 - Now that you have learned more about the cells that make up all the subsystems of our body, what questions do you still have?
2. There are no right answers, but encourage students to look back at their student guides and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their ideas and questions based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and gathering knowledge and skills for their final projects.

Assessment

1. Collect students' Task 4 Student Versions and assess the *Explore* using the 3-Dimensional Task 4 Rubric below. To maintain the authenticity of the Culminating Project, MS-LS1-1 will be assessed through this task rather than within the Culminating Project.
2. You may collect students' Project Organizer and assess using:
 - *Criteria of your choice*. We recommend using the 3-Dimensional Assessment matrix at the beginning of this document to inform your criteria.
 - This can be a formative tool to periodically look for trends in student understanding after the completion of a task. You can then use this formative data to inform any re-teaching as necessary.
3. You may also give students time to make revisions with one of the two options:
 - Students may make changes to their Project Organizer according to your comments OR
 - Ask students to exchange Project Organizers with a partner and give partners 5 minutes to give written feedback. Then allow students time to make changes to their work according to the feedback.

6th Grade Science Unit 1: Setting Things in Motion

Task 4: Got Cells?

Task 4 Rubric: Student conducts an investigation to produce evidence that living things are made up of cells, accurately using observations at the microscopic scale, not the macroscopic scale.

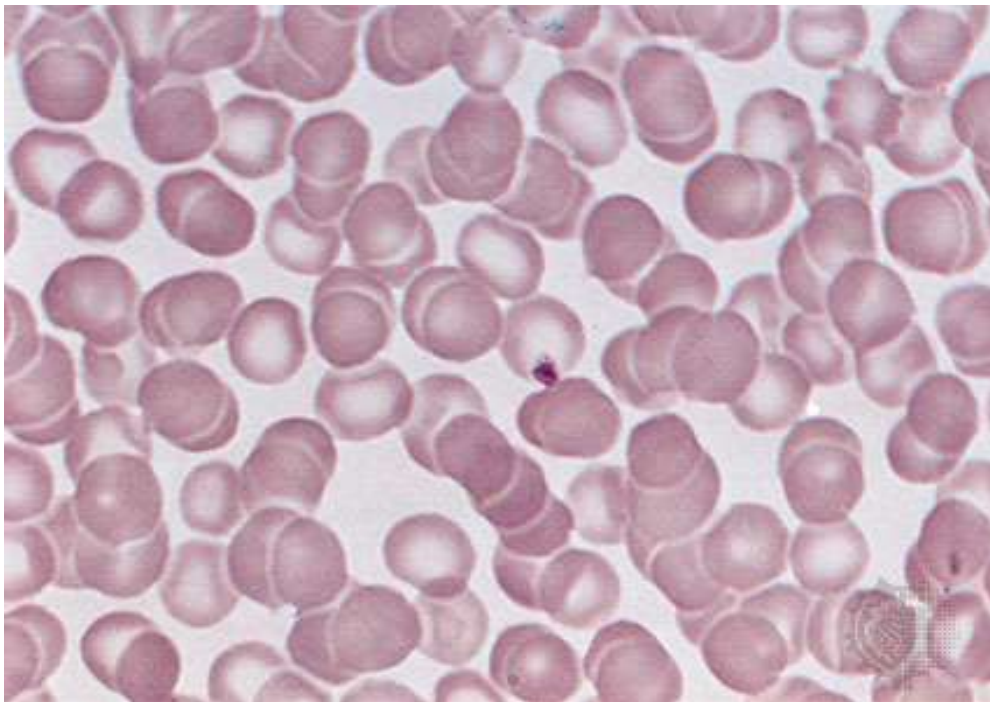
- Use to assess student responses in the *Explore* chart.
- Dimensions Assessed: SEP – Planning and Carry Out Investigations; DCI – LS1.A: Structure and Function; CCC – Scale, Proportion, and Quantity

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
<p>Student conducts an investigation to produce no accurate evidence that living things are made up of cells OR uses irrelevant observations at the macroscopic scale instead of the microscopic scale.</p>	<p>Student conducts an investigation to produce some accurate evidence that living things are made up of cells, accurately using observations at the microscopic scale, not the macroscopic scale.</p>	<p>Student conducts an investigation to produce mostly accurate evidence that living things are made up of cells, accurately using observations at the microscopic scale, not the macroscopic scale.</p>	<p>Student conducts an investigation to produce completely accurate evidence that living things are made up of cells, accurately using observations at the microscopic scale, not the macroscopic scale.</p>
<p>Look Fors:</p> <ul style="list-style-type: none"> • In the chart, student makes no accurate claims about which specimens are made up of cells (See Advanced Look-Fors for accurate identifications). <p>OR</p> <ul style="list-style-type: none"> • Student makes some accurate claims, but in their reasoning for the accurate claims, student only uses macroscopic observations of the specimen, which are irrelevant. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • In the chart, student makes some accurate claims about which specimens are made up of cells (See Advanced Look-Fors for accurate identifications). • In their reasoning for the accurate claims, student uses microscopic observations of the presence or lack of cell-like structures to support their claims. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • In the chart, student makes mostly accurate claims about which specimens are made up of cells (See Advanced Look-Fors for accurate identifications). For example, student inaccurately describes that cotton thread is made up of cells, but describes all other specimens correctly. • In their reasoning for the accurate claims, student uses microscopic observations of the presence or lack of cell-like structures to support their claims. 	<p>Look Fors:</p> <ul style="list-style-type: none"> • In the chart, student makes all accurate claims about which specimens are made up of cells. For example, all human and plant specimens are made up of cells, but not the cotton thread or printed paper. • In their reasoning for the accurate claims, student uses microscopic observations of the presence or lack of cell-like structures to support their claims.

Microscope Stations

Explore

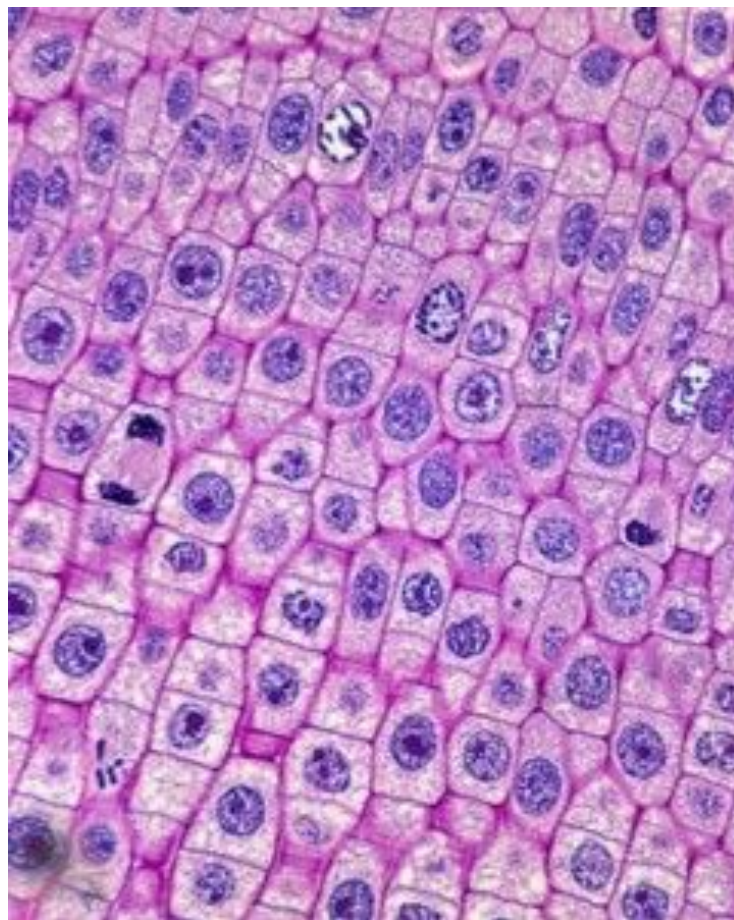
Station 1 – Human Blood



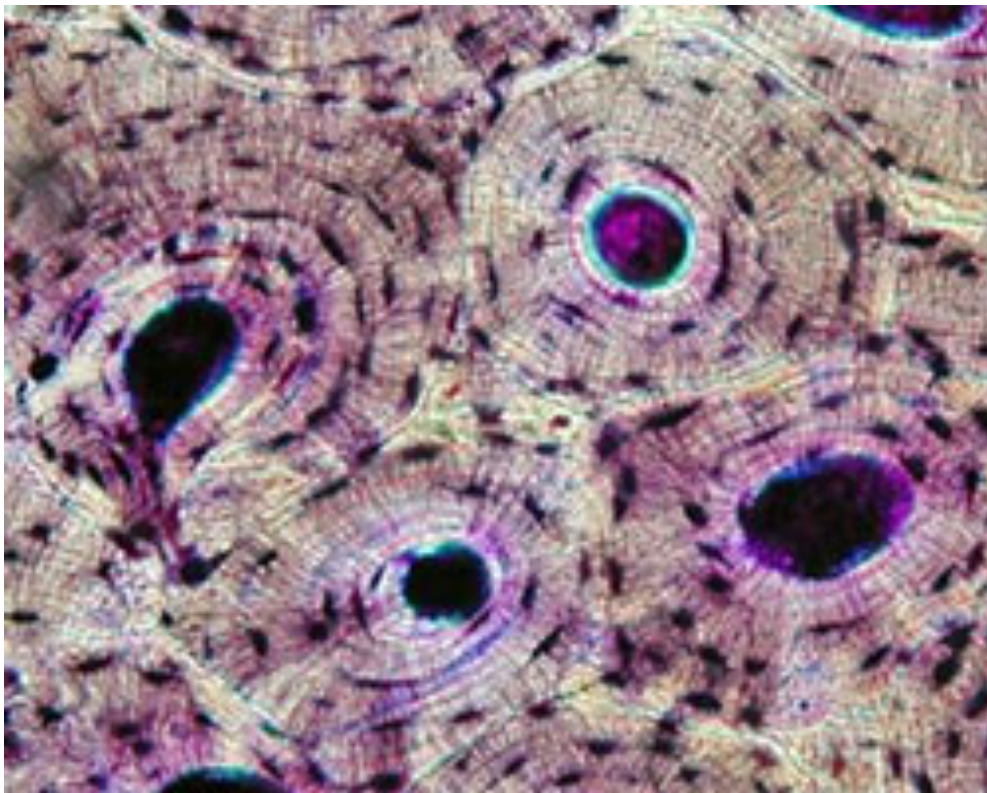
Station 2 – Human Skin



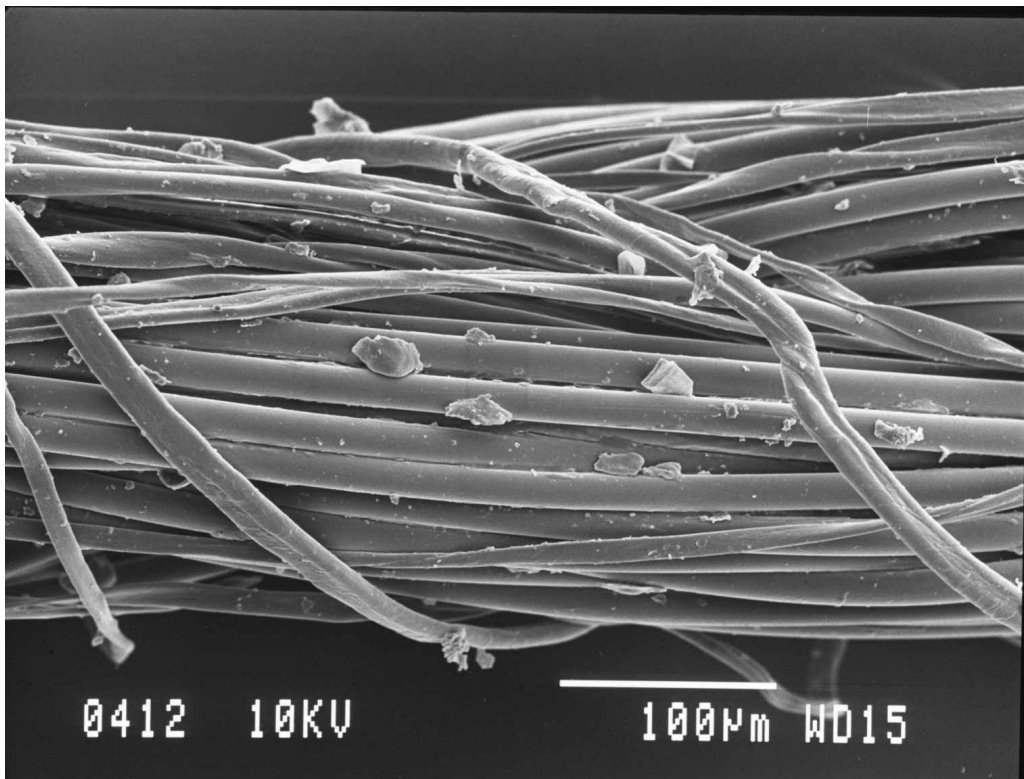
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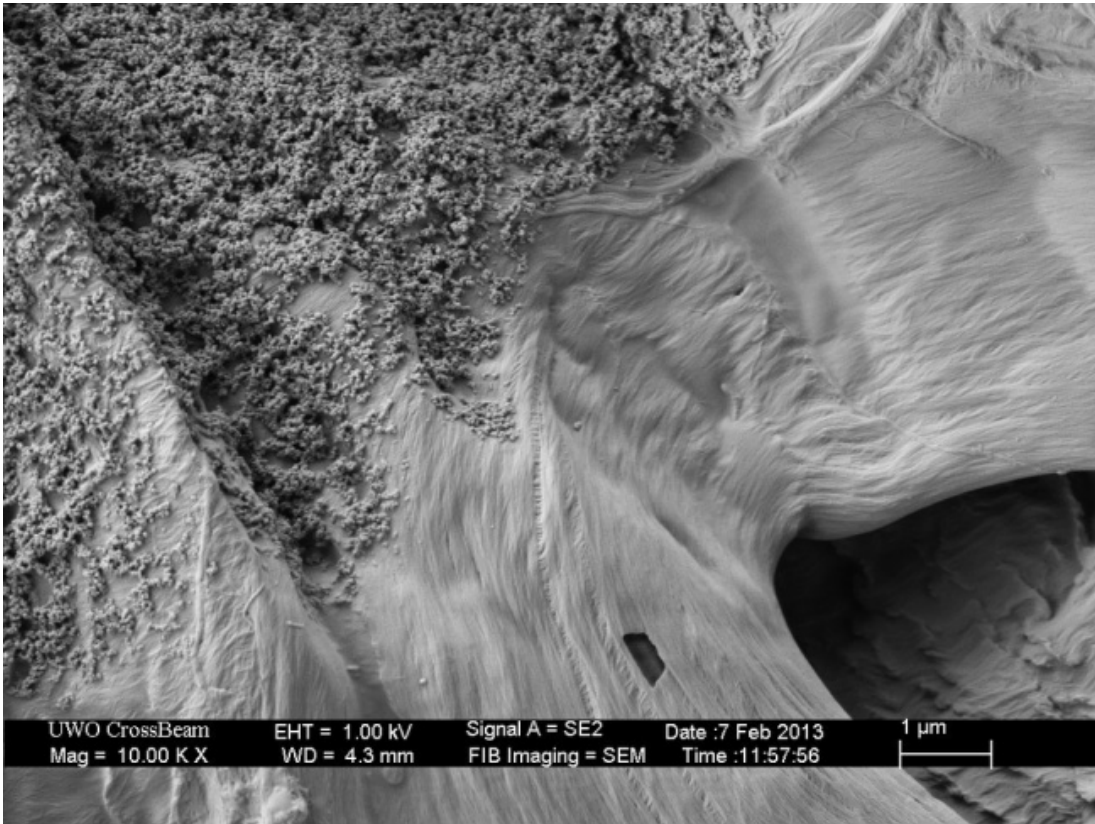
Station 3 – Human Bone



Station 4 – Cotton Thread



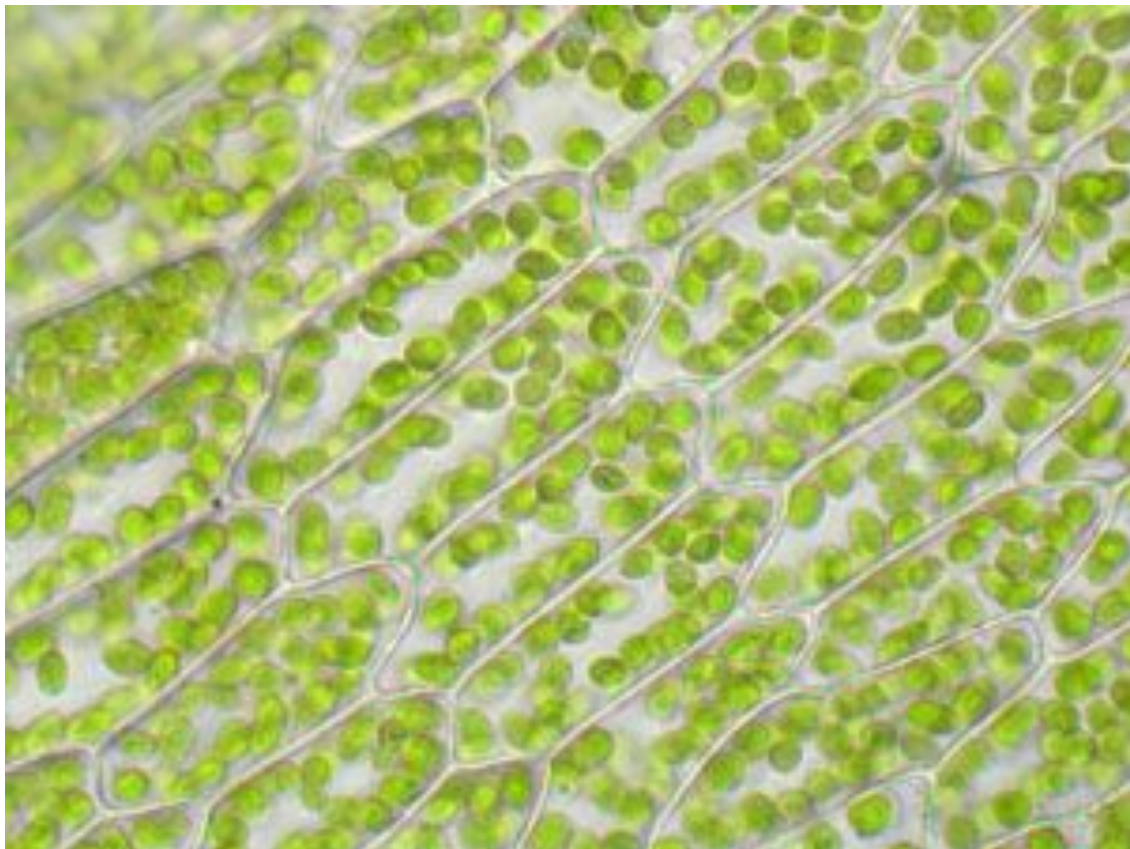
Station 5 – Printed Paper



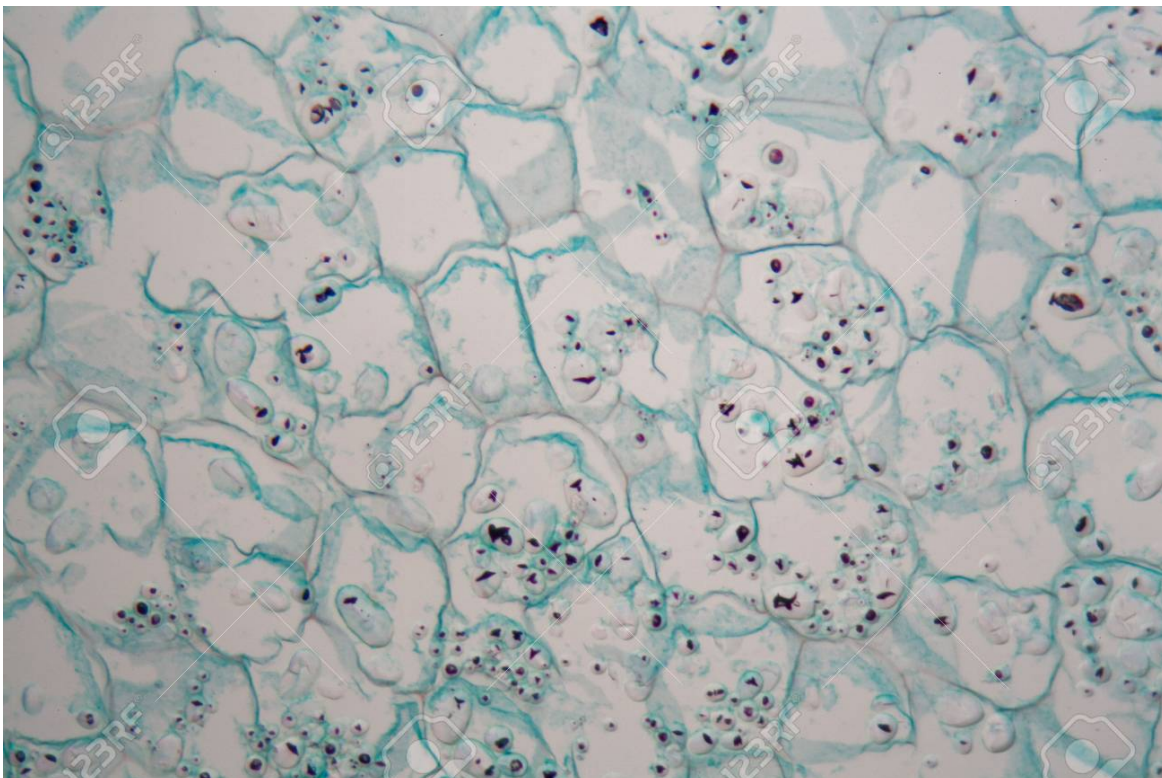
UWO CrossBeam EHT = 1.00 kV Signal A = SE2 Date : 7 Feb 2013
 Mag = 10.00 K X WD = 4.3 mm FIB Imaging = SEM Time : 11:57:56

1 μm

Station 6 – Moss Leaf



Station 7 – Cork Tree Bark



6th Grade Science Unit 1: Setting Things in Motion

Task 5: Parts of a Whole



Unit Essential Question: *How do our bodies produce and use the energy needed to move objects?*

Introduction

In the last task, students began to zoom in to explore the human body on a microscopic scale, discovering that as living things, we are made up of different types of cells. This task continues their exploration of the microscopic scale by diving into the function of a cell as a whole and the ways in which parts of the cell contribute to the function. This provides the final link for students to think about why their bodies are able to put objects in motion in different activities. By using and developing different types of models, students discover that there is a specific part of the cell that produces energy for the cell, allowing it to function. This is the energy that students eventually see in the movement of objects in their chosen activity for their culminating project.

Alignment Table

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]</p>	<p>Developing and Using Models</p> <ul style="list-style-type: none"> Develop and use a model to describe phenomena. 	<p>LS1.A: Structure and Function</p> <p>Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.</p>	<p>Structure and Function</p> <ul style="list-style-type: none"> Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.
<p>Equity and Groupwork</p> <ul style="list-style-type: none"> Discuss and compare models with a partner. Participate in group roles to analyze an analogy and come to consensus on matching terms. Participate in a structured partner routine to give and receive feedback. 			

6th Grade Science Unit 1: Setting Things in Motion**Task 5: Parts of a Whole****Language**

- Compare and contrast different types of models.
- Match scientific definitions to an analogy.
- Represent relationships in visual and written models.
- Use the Stronger Clearer method to strengthen and clarify a model.

Learning Goals

This learning task asks students to develop models to show how parts of a cell interact in order for the whole cell to function. More specifically, the purpose is to:

- Examine different types of models with a simple and familiar example.
- Match new scientific definitions to an analogy for cell parts and function.
- Develop a visual model to show the relationships amongst cell parts.
- Use the Stronger Clearer method to gather and receive feedback to improve their models.
- Apply knowledge of cells parts and function to explain where the energy in a moving object initially comes from.

Content Background for Teachers

In this task, students learn about cell parts and their functions, as well as how they contribute to the functioning of the cell as a whole. While there are many different cell parts, this task focuses on three main ones: the nucleus, the mitochondria, and the cell membrane.

The nucleus is one of the most important structures in the cell. It acts as the command center because it has all the instructions that decide what protein products are made in the cell. These instructions are in the form of DNA. Various sections of the DNA can be copied and sent out of the nucleus to the ribosomes, like recipes, where they are translated into protein products. These protein products may remain in the cell or may be sent out to other cells. Each type of cell creates different kinds of products.

The mitochondrion is often referred to as the powerhouse of the cell because it produces the energy the cell needs to function. When a cell takes in food molecules, also known as sugar or glucose, it is the job of the mitochondrion to break these down into a form of energy the cell can use—ATP. This energy conversion process, known as cellular respiration, also requires oxygen and releases carbon dioxide and water as byproducts.

The cell membrane is essential to both of the above cell parts. It holds in all the parts of the cell and acts as a gatekeeper for what materials can come into and out of the cell. For example, the cell membrane allows in the oxygen and sugar that the mitochondria needs to make energy. It also lets out the carbon dioxide and water that are produced in the mitochondria, as well as the protein products produced by the ribosomes.

Because this unit's culminating project focuses on humans, we only emphasize the relevant animal cell parts. However, you may also choose to show examples of plant cells and point out the additional main cell parts in plant cells (cell wall and chloroplasts).

6th Grade Science Unit 1: Setting Things in Motion

Task 5: Parts of a Whole

Academic Vocabulary

- Model
- Labeled Diagram
- Flowchart
- Mind Map
- Analogy
- Cell Part
- Mitochondria
- Nucleus
- Cell Membrane
- Sugar
- Proteins
- Energy

Time Needed (Based on 45-Minute Periods)

4 Days

- Engage: 0.5 period
- Explore: 0.5 period
- Explain: 1 period
- Elaborate: 1 period
- Evaluate and Reflection: 1 period

Materials

- Unit 1, Task 5 Student Version

Explore

- *Cell Definition Cards*, cut (1 per group)
- *Cell Analogy* (1 per group)
- Blank Piece of Paper (to draw factory)

Evaluate

- Project Organizer Handout
- Computers/Tablets to Conduct Research

Instructions**Engage**

1. Introduce Task 5: In Task 4, you zoomed in on various specimens to learn that all living things, like yourself, are made up of different types of cells!
 - Before you pass out their student guide, give students time to reflect individually or with a partner about the questions they recorded at the end of the last task. Share a few of these out as a class, using facilitating questions to guide students toward questions that relate to this task.
2. Transition to Task 5: How do these cells allow us to do the things we like to do? How do they provide the energy our bodies need to move objects?

6th Grade Science Unit 1: Setting Things in Motion

Task 5: Parts of a Whole

- Now pass out their Task 5 student guide.
3. Because modeling may be a new practice for students, this task begins with an examination with a few different types of models using a simple and familiar example—a smartphone battery draining in power throughout the day.
 4. In their Student Guides, students are shown three different kinds of models: a labeled diagram, a flowchart or mind map, and an analogy.
 - We recommend introducing the context and reviewing the three kinds of models as a class first before students compare them in pairs.
 - Pairs of students then use the discussion questions in their Student Guides to help them compare the different kinds of models and think about what the purpose of a model is and which one is best for this particular scenario.
 5. Below are some sample student responses to the discussion questions:
 - 1: The purpose of a model is to represent an idea or system in a way that is easier to understand.
 - 2: The labeled diagram actually shows what the object looks like. The flowchart/mindmap describes the process or relationship between the different parts. The analogy compares it to something similar and easier to understand.
 - 3: I think the labeled diagram is the most helpful because it actually shows the battery draining and all the reasons why. The flowchart/mind map might not actually always work in that order.
 6. Debrief these discussion questions as a class.
 - We encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).

Explore

1. In many science classes, students will be told everything they need to know about cell parts and they then use the information to write an analogy. This activity flips that process, allowing the analogy to be the method in which students learn about cell parts and functions.
 - This gives students practice at the SEP of **Developing and Using Models** as students engage with an analogy model to provide evidence of cell parts and functions.
2. Assign roles to each group. You may use whatever roles you prefer. We recommend the use of the Facilitator, Materials Manager, Harmonizer, and Recorder.
 - Ask the Facilitator to read the directions and to make sure everyone understands the task.
 - Ask the Materials Manager to gather the materials needed to complete the task.
 - Ask the Harmonizer to make sure that everyone contributes their ideas and that everyone’s voice is heard.
 - Ask the Recorder to make sure the group is recording their analogy matches and reasoning in their Student Guides.
3. Distribute a set of *Cell Definition Cards*, the *Cell Analogy*, and a blank sheet of paper to each group of students.

6th Grade Science Unit 1: Setting Things in Motion

Task 5: Parts of a Whole

- Students cut the *Cell Definitions* into actual cards.
- Each group reads the analogy aloud and draws the factory. They can then place the *Cell Definition Cards* in the right places on their drawing.
- Students should record their analogy matches and reasoning in the Student Guides. A sample is provided below:

Cell Part or Substance		Part of the Analogy	Because...
The Mitochondria...	...is/are like...	Power generators	They both make energy.
The Nucleus...		Factory control center	They both decide what products are made and give instructions.
The Cell Membrane...		The Shipping/Receiving Department and Workers	They both monitor what goes into and out of the factory/cell.
Sugar...		Fuel	Both come into the factory/cell to be used to make energy.
Proteins...		Products	They are both specific items made by the factory/cell and are shipped out of the factory/cell.

4. As a class, debrief each cell part/substance and its associated part of the analogy. Try to come to consensus on all cell parts and substances by asking students who disagree to share their reasoning.
 - This is also a great time for students to discuss limitations of using a factory as a model for a cell.
 - Again, we encourage using equity sticks to foster more equitable participation in class-wide discussions like these (See “How To Use This Curriculum” for more details).

Explain

1. While the above analogy was helpful to show students the function of a cell and each of its parts, often times a visual model is better for showing relationships within a system, like a cell. This emphasizes to students that while multiple kinds of models can be used, some are more helpful than others, depending on the purpose.
 - This again allows practice of the SEP of **Developing and Using Models** as students develop a model to provide evidence of the interaction between cell parts.
2. Emphasize to students that the purpose of this model is to show all the connections between the main cell parts
 - In their Student Guides, students are given a box of key terms they must use in their visual model, but they may always add more as necessary. We recommend having students write the key terms on post-its first, so they can move them around as they decide how to structure their model.
 - For students who are struggling with the format, you may want to encourage them to use arrows between parts and corresponding labels to describe these connections.

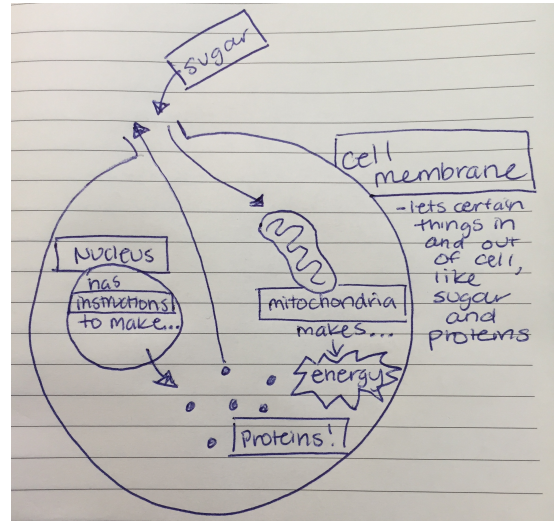
6th Grade Science Unit 1: Setting Things in Motion

Task 5: Parts of a Whole

- At the bottom of the models, students are asked to explain how each of the cell parts contributes to the cell's overall function. This emphasizes the CCC of **Structure and Function** as students focus on how relationships between cell parts can be analyzed to determine the function of a cell.

- We recommend students do this activity independently because they will be using the *Stronger Clearer* method in the next activity to gather feedback from multiple partners.

- Though there will be great variation in the format of students' models, the image to the right shows what one may look like.

**Elaborate**

- Students will now participate in a language routine known as *Stronger Clearer*. This activity gives students the opportunity to share their ideas, gather feedback, and revise their models. This protocol is especially useful at this stage since the practice of modeling is likely new to many students.
- Students will share with three different partners, allowing them to discuss feedback and record any notes each time. Once complete, students should be given time to individually revise their models based on their discussions. A protocol is provided in their student guide.
- This revised model can be a good option for formative assessment. Collect student work to identify trends in students' ability to develop models that provide evidence of the interaction between cell parts for cell function. See "How to Use This Curriculum" for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.
- Return to the whole-class concept map from the Lift-Off Task.
 - In small groups, have students brainstorm new concepts and new connections that they have learned in this task, as well as any new questions that have come up for them. Then have groups share these aloud in a class-wide discussion and add to the class concept map. The use of equity sticks is encouraged for more equitable participation in class-wide discussions (See "How To Use This Curriculum" for more details).
 - Some facilitating questions to ask students are: What new ideas/concepts do you want to add to the map? What connections do you want to add or change? What is your reason for that addition/revision? What connections can we make between the questions/ideas already on the map? What new questions do you have about the phenomenon?
 - Draw circles around each question and boxes around each concept.
 - Write connector words to describe connections between the concept boxes.
 - For this task, students may begin to connect some of their previous question circles to concept boxes about the following: cell parts and functions, where energy is created in the body.

6th Grade Science Unit 1: Setting Things in Motion**Task 5: Parts of a Whole**

- Have students analyze the additions to the class concept map for as many examples of this task’s crosscutting concept as they can find. Once a student has identified the crosscutting concept, you can trace the circle in the corresponding color (decided on in the Lift-Off task). We recommend asking students to share key words that helped them identify the crosscutting concept for that concept or question. Some identifying words students might look for are:
 - **Structure and Function:** These could be phrases such as, “its shape affects its function by,” “structure causes it to,” “functions this way because of,” etc.
- Once again, the purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content, but will also help their oral and written language development.

Evaluate: Connecting to the Culminating Project

1. Students independently complete the Task 5 section of the Unit 1 Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
2. Students have been asked to teach people how their bodies make the movement of objects possible in a specific activity. Their prompt is as follows: 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 below. This will show how energy from your body is able to move your object!

Reflection

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
 - At the beginning of this task, you examined different types of models you might use in science. Based on what you learned in this task, when do you think each type of model should be used (diagram vs. flowchart vs. analogy)?
 - In this task, we focused on the crosscutting concept of **Structure and Function**: Relationships between parts can be analyzed to determine how systems function. Where did you see examples of **Structure and Function** in this task?
 - Now that you have learned more how cells function, what questions do you still have?
2. There are no right answers, but encourage students to look back at their student guides and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their ideas and questions based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and gathering knowledge and skills for their final projects.

6th Grade Science Unit 1: Setting Things in Motion**Task 5: Parts of a Whole****Assessment**

1. You may collect students' Project Organizer and assess using:
 - *Criteria of your choice.* We recommend using the 3-Dimensional Assessment matrix at the beginning of this document to inform your criteria.
 - This can be a formative tool to periodically look for trends in student understanding after the completion of a task. You can then use this formative data to inform any re-teaching as necessary.

2. You may also give students time to make revisions with one of the two options:
 - Students may make changes to their Project Organizer according to your comments OR
 - Ask students to exchange Project Organizers with a partner and give partners 5 minutes to give written feedback. Then allow students time to make changes to their work according to the feedback.

Cell Definition Cards

*Explore***Mitochondria**

A cell part that breaks down food molecules (sugar) into the kind of energy that can be used by the cell to function.

Nucleus

A cell part that has all the instructions for the cell's functioning and decides what proteins are made by the cell to be shipped outside the cell.

Cell Membrane

A cell part that holds in all other cell parts and has door-like openings to allow only *certain* materials (like sugars and proteins) to be let in and out of the cell.

Sugar

A food molecule that comes into the cell to be converted into energy the cell can use for functioning.

Proteins

Products made by the cell to help the whole body survive and function properly.

Cell Analogy*Explore*

A factory's job is to create a specific product, so each type of factory creates a different kind of product. Each worker and machine in the factory does a specific and different job. However, all the machines and workers work together to make sure the factory functions properly.

The power generators create all the energy that the factory needs. In order to make the kind of energy that is used by the factory, the power generators need fuel. The fuel is delivered from outside the factory and comes in through the Receiving Department, where a Receiving Worker decides what materials can enter the factory.

The factory control center decides what product the factory will make and gives instructions on how it will make it. Once the products are made, they are shipped out of the factory through a door in the Shipping Department, which is monitored by the Shipment Worker.