**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**

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| --- | --- | --- | --- |
| **Performance Expectations** | **Science and Engineering Practices** | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **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.] | **Planning and Carrying Out Investigations**   * Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. | **LS1.A: Structure and Function**  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). | **Scale, Proportion, and Quantity**   * Phenomena that can be observed at one scale may not be observable at another scale. |
| **Supplementary Science and Engineering Practices**   * Analyzing and Interpreting Data   + Analyze and interpret data to determine similarities and differences in findings. | | | |
| **Equity and Groupwork**   * Discuss and come to consensus on a definition for “cell”. * Participate in group roles in an investigation and subsequent data analysis. | | | |
| **Language**   * 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. | | | |

**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

**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*.

1. 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?

1. 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.

1. 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.
   * 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.

1. 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.

1. 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.

1. 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:

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| --- | --- |
| **Grouping 1** | **Grouping 2** |
| Which images were similar? List the specimens here:   * *Human Blood* * *Human Skin* * *Human Bone* * *Moss Leaf* * *Cork Tree Bark* | Which images were different from the majority? List the specimens here:   * *Cotton Thread* * *Printed Paper* |
| Describe what these images have in common.  *All of these images have repeating circular structures that are packed together.* | Describe how these images were different from the majority of other images.  *These images don’t have cell-like structures. The printed paper seems to have no common structure. The cotton thread has bundled fibers* |

1. 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.

1. 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:
     1. 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.*
     2. 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.*
2. 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.
3. 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.
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?

1. 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.

1. 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.

**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

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| --- | --- | --- | --- |
| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| 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. | 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. | 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. | 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. |
| **Look Fors:**   * In the chart, student makes no accurate claims about which specimens are made up of cells (See Advanced Look-Fors for accurate identifications).   OR   * Student makes some accurate claims, but in their reasoning for the accurate claims, student only uses macroscopic observations of the specimen, which are irrelevant. | **Look Fors:**   * 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. | **Look Fors:**   * 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. | **Look Fors:**   * 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. |