**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** |
| **MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.**[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.*] | **Engaging in Argument From Evidence**   * 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**   * 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. | **Systems and System Models**   * Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. |
| **Supplementary Science and Engineering Practices**   * Developing and Using Models   + Develop and/or use a model to predict and/or describe phenomena. * Planning and Carrying Out Investigations   + Conduct an investigation […] to produce data to serve as the basis for evidence that meet the goals of the investigation. | | | |
| **Equity and Groupwork**   * 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. | | | |
| **Language**   * 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
* 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.

* 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.

1. 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.

1. 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.

1. 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.

1. 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.

1. 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**

1. 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.

1. 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.
2. 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... |

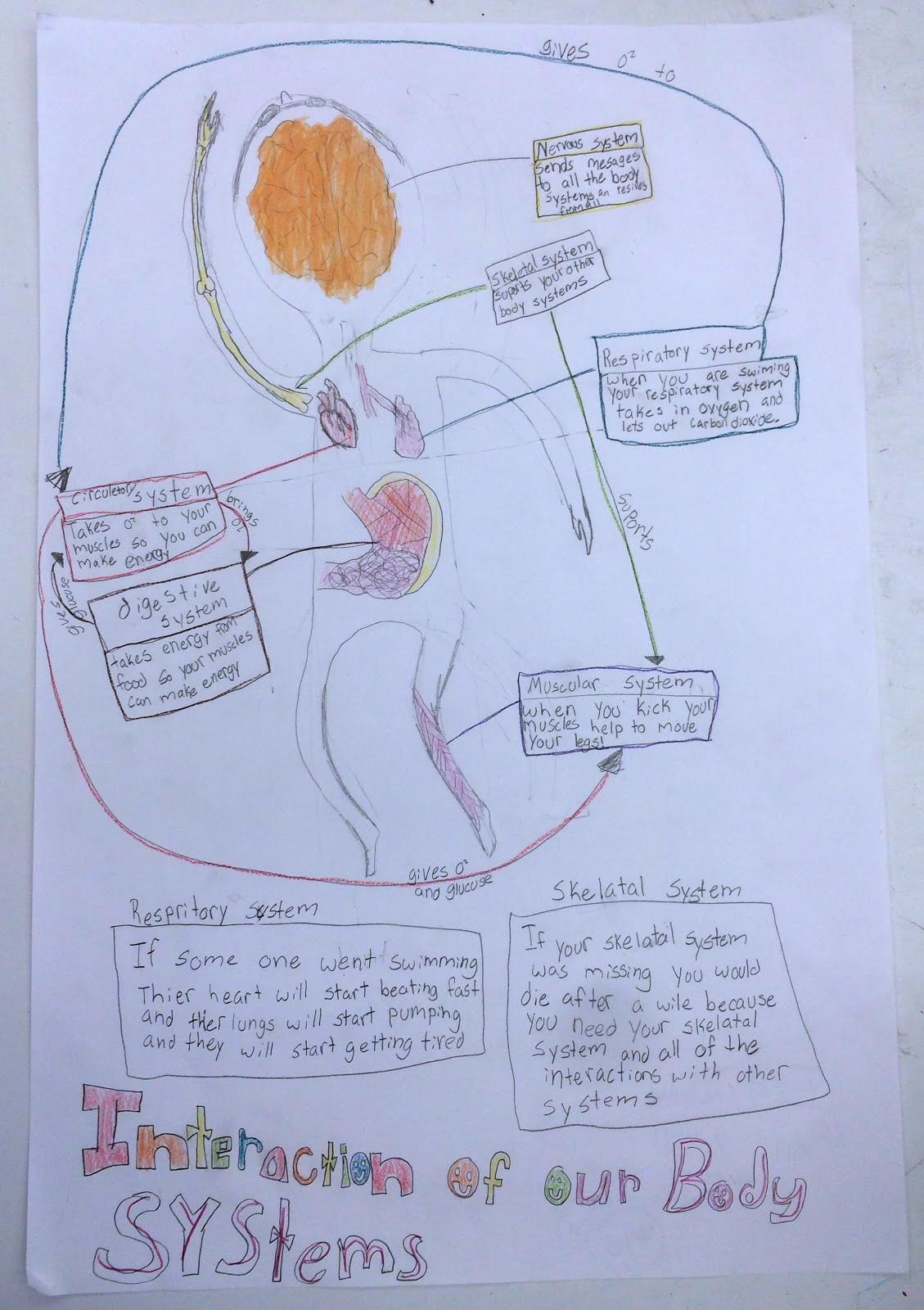
|  |  |
| --- | --- |
| **Claim**: | I disagree with the student’s argument because there are many more subsystems in the human body that must interact to do exercise. |
| **Evidence and Reasoning**: | The experiment showed that the respiratory and circulatory systems are involved because heart rate 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. |

1. 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**

1. 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.

1. 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.
2. 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.

1. 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 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?

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. 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.