**Unit Essential Question:** *How do humans impact organisms around the world and what can we do about it?*

**Introduction**

In Task 2, students explored what kinds of animal behaviors and plant structures affect the probability that organisms will survive and reproduce. In this task, students learn that this ability to survive and reproduce is at risk for many organisms because of the rise in global temperatures. Using the same examples from Task 2, students research what happens when an organism’s environment is compromised so much that it affects these behaviors and structures. By focusing on their own organism, they are able to do some of the research needed for their Culminating Project. However, they are also able to see that the impact of rising global temperatures is a broader issue as they learn about other organisms through a mock science conference.

**Alignment Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Expectations** | **Science and Engineering Practices** | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.** [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.] | **N/A**  **Engaging in Argument From Evidence** addressed in Task 2. | **LS1.B: Growth and Development of Organisms**   * Animals engage in characteristic behaviors that increase the odds of reproduction. * Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. | **Cause and Effect**   * Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. |
| **MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.\*** [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).] | **Designing Solutions**   * Apply scientific principles to design an object, tool, process or system. | **ESS3.C: Human Impacts on Earth Systems**   * Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things. * Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. | **Cause and Effect**   * ~~Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.~~ |
| **MS-ETS1-1***.* **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** | **Asking Questions and Defining Problems**   * Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. | **ETS1.A: Defining and Delimiting Engineering Problems**   * The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. | **No CCC listed** |
| **Equity and Groupwork**   * Participate in group roles to conduct research and make a scientific poster. * Brainstorm ideas with a partner. * Use the “Design Thinking Post-It” Method to brainstorm solutions as a group. * Give constructive peer feedback. | | | |
| **Language**   * Read scientific research and extract key ideas. * Take notes based on key ideas from research. * Represent research using visuals and text. * Read ideas and cluster by similarity. | | | |

**Learning Goals**

This learning task asks students to research and describe how global warming impacts organisms. More specifically, the purpose is to:

* Engage prior knowledge of plants and animals affected by rising global temperatures.
* Research their chosen organism to learn how plant structures and animal behaviors are changing in response to global warming.
* Create a scientific poster to teach others about what they have learned about their organism.
* Brainstorm potential solutions to monitor or minimize the impact on their organism.
* Revise criteria and constraints based on research.

**Content Background for Teachers**

In this task, students explored organisms with specific plant structures or animal behaviors that help them survive and reproduce. As stated in Task 2, we specifically chose nesting, migration, bright flowers, and sex pheromones because these particular characteristics are currently being affected by global warming in the organisms we have identified. This task thus provides the connection between global warming, the plant structures and animal behaviors that affect reproduction, and any potential solutions to minimize this human impact.

For information specific to each organism, see the sources provided in the *Explore* Research Card, as well as the information table in the *Explore* section below.

**Academic Vocabulary**

* Dependent on each student’s research

**Time Needed (Based on 45-Minute Periods)**

4.5 – 6.5 Days

* Engage: 0.5 period
* Explore: 1-2 periods
* Explain: 1-2 periods
* Elaborate: 1 period
* Evaluate and Reflection: 1 period

**Materials**

* Unit 4, Task 3 Student Version

Explore (Per Group)

* Research Card (Optional)
* 1-2 Computers or Tablets, for research

Explain

* Poster (Per Group)
* Markers (Per Group)
* Post-Its (Optional – 3+ Per Person)

Elaborate (Per Group)

* Poster
* Post-Its (1 stack, split up between group members)

Evaluate

* Project Organizer Handout

**Instructions**

**Engage**

1. Introduce Task 3: In Task 2, you learned about the different animal behaviors and plant structures that allow organisms to survive and reproduce. 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 remember that global temperatures are rising! What happens if an organism’s environment changes in a way that affects their behaviors and structures? In this task, you will investigate how increasing temperatures are impacting organisms around the world.
   * Now pass out their Task 3 student guide.
3. Most students have heard about global warming in the news or in prior science classes. Have partners brainstorm a list of plants and animals they’ve heard are being affected by rising global temperatures. If they do know a lot about the organism, encourage them to add a description of how they are being affected.

* If students are struggling with this brainstorm, encourage them to think of images that they’ve seen. As an optional scaffold, you may want to project a few images to spark student thinking.

1. Share examples out in a class-wide discussion, making a class list on the board.

* 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 the last task, students saw examples of many different organisms with specific plant structures or animal behaviors that help them survive and reproduce. Now, they learn that as global temperatures rise, we are seeing these characteristics changing in response.

* Review the context with students as a class: As a group, you will be presenting a poster at a Science Conference focusing on the question: How is global warming affecting organisms around the world? Research the organism you chose for the Culminating Project to figure out how it is being impacted by rising global temperatures.
* As students research how a change to a structure or behavior affects survival and/or reproduction, they are likely to encounter the CCC of **Cause and Effect**. While each structure and behavior likely affects reproduction (effect) in some way, successful reproduction relies on several factors (causes), so these cause-and-effect relationships are best described in terms of probability as some increase the likelihood of reproduction and survival more then others.

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 materials and read the research aloud.
   * 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 notes in their Student Guide.
2. Distribute at least 1-2 tablets or computers to each group of students. Students can conduct research independently, but we have also provided a Research Card, which provides students at least one source for their organism as an option to use in their research.
3. The table below describes the types of relationships students may find in their research:

|  |  |
| --- | --- |
| **Organism** | **How This Is Affected By Global Warming** |
| Magpie Larks | Rising temperatures and decreased rainfall associated with global warming are reducing the availability of mud for making nests. Without mud, Magpie Larks are unable to protect their offspring. |
| Shorebirds | Global warming is causing reduced snow cover, which is affecting the populations of various prey for Arctic Foxes. Without their usual prey, Arctic Foxes are feeding on Shorebirds’ eggs in their nests. |
| Finnish Birds | Global warming has caused Finnish Birds to shift their breeding time earlier in the season. This means Finnish Birds are building nests on arable land before fields are plowed, so the eggs are destroyed when the fields are plowed. |
| Salmon | Salmon are migrating and spawning earlier because of the warmer temperatures. The changing conditions can make growth and survival more difficult when the babies are born, or migrating animals arrive before their food is available. Global warming is also reducing the amount of river water making it hard for salmon to migrate, and is causing extreme storms that wash out spawning locations. |
| Whooping Cranes | They are now migrating earlier in the spring and later in the fall because of warmer temperatures. This poses a risk of getting caught in snowstorms on their migration journey without food. |
| Hummingbird | Global warming is causing flowers to bloom earlier. Thus, hummingbirds are now arriving at the breeding grounds too late for flower blooms, and thus too late to find adequate food for their offspring. |
| Caribou | Spring plant growth occurs earlier than normal because of warming temperatures. This is happening well before calving, so many calves are dying without adequate food available at the breeding site. |
| Spider Orchid | Warming temperatures are causing bees to emerge much earlier and the Spider Orchids only slightly earlier. This mismatch between the timing of bees’ presence and the Spider Orchid’s flowering means Spider Orchids are not being pollinated. |
| Lilac | Warming temperatures are causing Lilacs to bloom earlier than normal. The insects that eat them are thus plentiful earlier, but then die out earlier as well. By the time birds arrive for breeding season, there are not enough insects for the birds to eat. |

**Explain**

1. Now that students have done the research, they are ready to create a poster of their findings to present to their classmates. A list of criteria is provided in their Student Guides.

* Again, as students describe how a change to a structure or behavior affects the survival and/or reproduction of their organism, they are emphasizing the CCC of **Cause and Effect**. While each structure and behavior likely affects reproduction (effect) in some way, successful reproduction relies on several factors (causes), so these cause-and-effect relationships are best described in terms of probability as some increase the likelihood of reproduction and survival more then others.

1. You may choose to have students present these posters any way you’d like. However, we recommend a gallery walk as a fun, kinesthetic way for students to learn and give feedback.

* To give feedback, we recommend providing each student with a few post-its and asking them to leave at least one positive and at least one constructive comment on a poster around the room. You may change the required number of comments as you see fit.

1. These posters are a good option for formative assessment. Walk around the room to observe posters and identify trends in students’ ability to accurately describe cause-and-effect relationships. See “How to Use This Curriculum” for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.

**Elaborate**

1. Students now understand the problem—organisms around the world are being affected by global warming. The question now becomes: what can we do about it? This begins to move them toward PE MS-ESS3-3, as they develop solutions for their Culminating Project.

Some students may not know what “monitoring” entails. It would be useful for the teacher to model one such monitoring protocol with an organism not on the research list (For example, using radio tracking tags to know the locations of endangered populations of black rhino). Students basically need to understand that monitoring means to keep track of any changes in organism population over time.

1. In this activity, students do a group brainstorm of potential solutions using the “Design Thinking Post-It Method”. Distribute post-its and a blank poster paper to each group of students and review the procedure with them in their Student Guide.

* Emphasize that the goal is to get as many ideas onto the poster as possible, no matter how far-fetched they may seem.
* You may wish to model the process with an easier, more familiar problem.

1. Students should end this brainstorm with post-it ideas clustered on a poster and their top ideas recorded in their Student Guides.

* Hearing other students’ ideas might trigger new ideas. These should also be recorded on a new post-it and added to the poster.
* We recommend taking a photograph of each of the posters in case students want to return to any of these original ideas later in the design process.

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: impacts of global warming on organisms and potential solutions to monitor or minimize this impact.
   * 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 3 section of the Unit 4 Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
2. You have been asked to create an advocacy video that describes the human impact on an organism and gives a potential solution. Their prompt is as follows: In this task, you learned about how humans are impacting your chosen organism through global warming and are well on your way to coming up with a solution!

* Summarize the ideas from your poster here.
  + Describe the feedback you received from peers and how you plan to revise it based on that feedback.
* Return to your criteria and constraints that you identified after Task 1. Based on what you have learned about your organism so far, how can you revise them or add to them?

1. This Evaluate again emphasizes the PE, MS-ETS1-1, as students more specifically define criteria and constraints.

**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 brainstorm a list of plants and animals affected by rising global temperatures. In what ways is your organism being affected similarly or differently by global warming?
* In this task, we focused on the crosscutting concept of **Cause and Effect**: Phenomena may have more than one cause, and sometimes relationships can only be described using probability. Where did you see examples of **Cause and Effect** in this task?
* Now that you have learned more about the impacts of global warming on organisms, 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.