Stanford NGSS Integrated Curriculum
An Exploration of a Multidimensional World

UNIT 4

A Warmer World

How do humans impact organisms around the world and what can we do about it?

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Stanford NGSS Integrated Curriculum: An Exploration of a Multidimensional World
Unit 4: A Warmer World

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

Total Number of Instructional Days: 24.5 – 26.5

Lift-Off Task:	**Task 1:**	**Task 2:**	**Task 3:**
Bad News For Bees	Heating Up	It Takes Two	Feeling the Impact

Connect to the Culminating Project using the Project Organizer

Group Culminating Project:
Create An Advocacy Video Describing a Method to Minimize Human Impact On An Organism

Individual Culminating Project
Compare and Evaluate Different Solutions

Unit 4 Pop-Out

6th Grade Science Unit 4: A Warmer World
Unit Overview

Storyline for Unit 4

Students have likely seen images and videos depicting very sad stories of animals affected by climate change. In this unit, students explore why global warming is happening, how it is affecting organisms around the world, and what they can do to minimize this human impact.

In the last unit, students learned about how algae are being affected by human-caused environmental changes—excess fertilizer runoff and changing weather conditions associated with climate change. In this Lift-Off Task, students are introduced to another organism that is affected by human-caused environmental change—bees. After looking at an infographic showing bee population data, students begin to generate questions that might help them better make sense of what is happening to the bee population. These questions will guide students throughout the unit as they continue to make sense of the declining bee population, its causes and effects, and what can be done to address the issue.

In Task 1, students explore the rise in global temperatures over the past century, including why they have risen and how this affects Earth. By introducing one piece of data at a time, students have an opportunity to process the evidence and use it to generate their own questions that drive further learning. By the end of this task, students will be able to explain why global warming occurs, and apply this new knowledge to define the problem facing their chosen organism for their culminating project.

Before students can explore what rising temperatures means for Earth and its organisms, they need to understand what affects the survival and reproduction of organisms in the first place. In Task 2, students will learn about the different animal behaviors and plant structures that help organisms to successfully survive and reproduce. In doing so, they will learn that these characteristics are often interrelated and thus organisms, like bees and flowering plants, rely on each other. This sets the stage for students to learn, in Task 3, how these animal behaviors and plant structures are negatively impacted by global warming. By the end of Task 2, students will be able to describe the specialized structures or behaviors that help their specific organism survive and reproduce.

In Task 3, students learn that an organism's ability to survive and reproduce is at risk 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 their behaviors and structures. By focusing on their own organism, students are able to complete the research required for their Culminating Project. However, students will also see that the impact of rising global temperatures is a broader issue as they learn about other organisms in a mock science conference format.

Once students have completed all tasks and their Project Organizers, they can begin work on their Culminating Project. Their Culminating Project is to pick a plant or animal affected by global warming and then design a method to minimize or monitor this impact. As a group, students will create an advocacy video that describes the human impact on their organism and gives a potential solution, thus replacing the sad and hopeless type of video we usually see. After presenting their videos to the class, each student will compare and evaluate all the solutions presented by their classmates, and present their evaluation in the format of their choice (report, poster, powerpoint, video, etc.). As compared to the other three units, Unit 4 is unique in that is introduces two PEs (MS-ESS3-3 and MS-ETS1-2) in the final project only and not during the tasks themselves. These PEs will be easier for students to understand in the full context of the project.

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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
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]	**Asking Questions and Defining Problems** ● Ask questions to identify and clarify evidence of an argument.	**ESS3.D: Global Climate Change** ● Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	**Stability and Change** ● Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
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**

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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.]	**Engaging in Argument From Evidence** ● Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**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	**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	**Cause and Effect** ● ~~Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.~~

removal of wetlands), and pollution (such as of the air, water, or land).]		increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**Engaging in Argument From Evidence** • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	**ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	**No CCC listed**

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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
Key Ideas and Details	CCSS.ELA-Literacy.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.	Task 2 Project
Text Types and Purposes	CCSS.ELA-Literacy.WHST.6-8.1: Write arguments focused on discipline-specific content.	Task 2 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 1 Task 2 Task 3 Project
	CCSS.ELA-Literacy.WHST.6-8.8: Gather relevant information from multiple print and digital sources, using search terms effectively.	Task 1 Task 2 Task 3 Project
	CCSS.ELA-Literacy.WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research.	Task 2 Task 3 Project

Middle School and 6th Grade Common Core Math Standards		Unit Task
Mathematical Practice	CCSS.MATH.MP.2: Reason abstractly and quantitatively.	Task 1 Project

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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.

6th 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

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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.* The principles relevant to this unit are outlined in the chart below:

Unit Task	EEI Principle	EEI Concept
Task 1 Project	Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.	Concept A: The goods produced by natural systems are essential to human life and to the functioning of our economies and cultures.
Lift-Off Task Task 1 Task 3 Project	Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.	Concept A: Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.
		Concept B. Methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems.
		Concept C: The expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems.
Task 1 Task 3 Project	Principle III: Natural systems change in ways that people benefit from and can influence.	Concept A: Natural systems proceed through cycles and processes that are required for their functioning.
		Concept C: Human practices can alter the cycles and processes that operate within natural systems.
Lift-Off Task Task 1 Task 3 Project	Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.	Concept A: The effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.
		Concept B: The byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect.
		Concept C: The capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts.
Project	Principle V: Decisions affecting resources and natural systems are complex and involve many factors.	Concept A: There is a spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.

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Teacher Materials List

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

Overall Unit – All Tasks
- Unit 4, Task Cards Student Version, Lift-Off and Tasks 1 through 3
- 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
- Poster paper and markers
- *See Instructions in Lift-Off for other optional materials to use for the class concept map

Task 1 (4 days, based on 45-minute periods)

Per Student
- Task Card Student Version: Task 1
- Project Organizer
- Task Card Student Version: Culminating Project (for list of organism options)
- Computers or Tablets for research (optional)

Per Group
- Evidence Cards #1-5
- Computer or Tablet (for video)

Whole Class
- Projector and Speakers

Task 2 (4 days, based on 45-minute periods)

Per Student
- Task Card Student Version: Task 2
- Project Organizer
- Computers or Tablets for research (as necessary)

Per Station
- Station Cards (1-2 copies per station) – may need to duplicate stations based on class size

Task 3 (4.5 – 6.5 days, based on 45-minute periods)

Per Student
- Task Card Student Version: Task 3

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Teacher Materials List

- Project Organizer
- Post-Its (Optional – 3+ per person)

Per Group

- Research Card (Optional)
- 1-2 Computers or Tablets, for research
- 2 Poster Papers
- Markers
- Post-Its (1 stack, split up between group members)

Culminating Project (10 days, based on 45-minute periods)

Advocacy Video

- Recording Device (phone, computer, camera, etc.)
- Movie Editing Software (Optional)
- Poster Paper (Optional for visuals)
- Color pencils/markers or computer graphics (Optional for Visuals)

Solutions Evaluation

- Depends on their choice in format

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Building on Prior Knowledge

In Unit 3, students began to explore human impact on natural systems through their Culminating Project, as they thought about why algal blooms have become more common in recent years. In this unit, students continue with this theme, specifically looking at why global temperatures are on the rise and what this means for organisms around the world. In this culminating project, students are asked to design a method to monitor and minimize this type of human impact on a particular organism.

The integrated model requires students to access and use a wide range of ideas from prior grades. This content knowledge spans five different Disciplinary Core Ideas in this unit: ESS3.D: Global Climate Change, ETS1.A: Defining and Delimiting Engineering Problems, LS1.B: Growth and Development of Organisms, ESS3.C: Human Impacts on Earth Systems, and ETS1.B: Developing Possible Solutions.

As students explore these core ideas, they build on their skills in the following science and engineering practices: Asking Questions and Defining Problems, Designing Solutions, and Engaging in Argument From Evidence. In addition to science and engineering practices, students also continue to build on their knowledge of the crosscutting concepts of Cause and Effect and Stability and Change.

*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 4

Disciplinary Core Ideas	K-2	3-5	6-8
ESS3.D Global Climate Change	N/A	N/A	Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.
ETS1.A Defining and Delimiting Engineering Problems	A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. Asking questions, making observations, and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem.	Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	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.
LS1.B Growth and Development of Organisms	Parents and offspring often engage in behaviors that help the offspring survive.	Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.	Animals engage in behaviors and plants have specialized structures that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.

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ESS3.C Human Impact on Earth Systems	Things people do can affect the environment, but they can make choices to reduce their impacts.	Societal activities have had major effects on land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	Human activities have altered the biosphere sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.
ETS1.B Developing Possible Solutions	Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

Science and Engineering Practices	K-2	3-5	6-8
Asking Questions and Defining Problems*	Asking questions and defining problems in K-2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Define a simple problem that can be solved through the development of a new or improved object or tool.	Asking questions and defining problems in 3-5 builds on prior experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	Asking questions and defining problems in 6-8 builds on prior experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions to identify and clarify evidence of an argument. • 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.
Designing Solutions*	Designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in designing solutions. • Use tools and/or	Designing solutions in 3-5 builds on prior experiences and progresses to the use of evidence in designing multiple solutions to design problems. • Apply scientific ideas to	Designing solutions in 6-8 builds on prior experiences and progresses to include designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

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	materials to design and/or build a device that solves a specific problem. • Generate and/or compare multiple solutions to a problem.	solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	• Apply scientific ideas or principles to design an object, tool, process or system.
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). • Construct an argument with evidence to support a claim. • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.	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). • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.	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). • Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Evaluate competing design solutions based on jointly developed and agreed-upon criteria.

*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*	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. • Events have causes that generate observable patterns.	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. • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship.	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. • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • Phenomena may have more than

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			one cause, and some cause and effect relationships in systems can only be described using probability.
Stability and Change	Students observe some things stay the same while other things change, and things may change slowly or rapidly. • Some things stay the same while other things change. • Things may change slowly or rapidly.	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change. • Some systems appear stable, but over long periods of time will eventually change.	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time. • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

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

Progression of Knowledge from Kindergarten – 8th grade

ESS3.D. Global Climate Change: This DCI is not introduced until the middle school PE addressed in this unit. However, in earlier grades, students do engage with various aspects of natural resource use and human impact that offer connections to this DCI. For example, in 4th grade, students learn about how energy is derived from natural resources and their use affects the environment. Then in 5th grade, students begin to think about general human impacts on Earth's environments and what they can to protect these environments. In this unit, students focus in one specific environmental impact—how human activities are contributing to the rise in global temperatures.

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

MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

ETS1.A. Defining and Delimiting Engineering Problems: In Kindergarten through second grade, students first begin to approach situations as problems to be solved through engineering. They learn to ask questions and gather information to clearly understand a problem. In third through fifth grade, students build on an understanding of the problem to also identify criteria and constraints surrounding the problem. In this sixth grade unit, students take this process a step further by defining criteria and constraints more precisely, including consideration of scientific principles and other relevant knowledge. In Kindergarten to second grade, students focus on the science and engineering practice of Asking Questions in order to help them with the practice of Defining Problems, which continues to be the main focus in subsequent grades.

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

K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

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.

LS1.B. Growth and Development of Organisms: In first grade, students begin to engage with this DCI by thinking about plant and animal behaviors that help the offspring to survive. In third through fifth grade, students take a step back from survival behaviors and look at the big picture of organisms—that while diverse, they all have a life cycle that involves reproduction. In Unit 3, students focused on the growth aspect of the life cycle as they gathered evidence for how environmental and genetic factors influence the growth of plants. In this unit, students build on their prior knowledge from first grade as they learn that certain animal behaviors and plant structures can increase the odds of reproduction—which is another key aspect of the life cycles that they explored in third grade. Students first focus on the crosscutting concept of Patterns, but later switch to the lens of Cause and Effect. There is also a wide variety of Science and Engineering Practices across the PEs, as shown below.

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

1-LS1-2 Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

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 probability of successful reproduction of animals and plants respectively.

MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

ESS3.C. Human Impacts on Earth Systems: In Kindergarten through second grade, students begin to think about how the things that people do to live comfortably can affect the world around them. In turn, they also consider how they might make choices to reduce this impact. In third-fifth grade, students continue an exploration of problematic human impacts and the corresponding solutions communities are already putting in place. This sets the stage for this unit, as students dig into a specific human impact to design their own method for monitoring and minimizing that human impact. In a later middle school unit, students will envision the bigger picture by examining how increases in human population and per-capita consumption cause a greater negative impact on Earth's systems. Aside from this unit, students fluctuate

mostly between the SEPs of Engaging in Argument From Evidence and Obtaining, Evaluating, and Communicating Information. Throughout all the Performance Expectations below, students are engaging with the CCCs of Cause and Effect or Systems and System Models.

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

K-ESS2-2 Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

K-ESS3-3 Communicate solutions that will reduce the impact of humans on the land, water, air, and/or living things in the local environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS- ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capital consumption of natural resources impact Earth's systems.

ETS1.B. Developing Possible Solutions: In Kindergarten through second grade, students begin communicating multiple designs in the form of diagrams and sketches. By third to fifth grade, students move from mere drawings to actually testing out their designs to see how they perform under different conditions. Students then use this data to make improvements. As in Kindergarten through second grade, students practice the idea that communication of designs with peers is an essential part of the design process. In Unit 2, students moved towards using data from testing solutions to inform improvements, focusing on the idea that parts of different solutions can be used to make an even better solution. In this unit, students focus on another PE associated with this DCI, which asks students to use systematic processes to evaluate solutions for how well they meet criteria and constraints. At the different grade levels, students engage in a variety of different science and engineering practices: Developing Models in K-2, Designing Solutions (specifically comparing solutions) in 3-5, and Analyzing and Interpreting Data and Engaging in Argument From Evidence in 6-8. This is representative of the different practices students are engaging with, described above.

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

K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to

identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

6th Grade Science Unit 4: A Warmer World
Culminating Project

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

Introduction

In the Lift-Off Task, students saw that bee populations are drastically decreasing. We are seeing these kinds of changes in organisms around the world—changes in population size and even in behavior and in traits. Why is this happening and what can we do about it?

In this culminating project, each group's task is to pick a plant or animal affected by global warming and then design a method to monitor and minimize this impact. Students have likely seen images or videos depicting very sad stories of animals affected by climate change. While it is certainly sad, there is still hope! As a group, students create an advocacy video that describes the human impact on their organism and gives a potential solution, thus replacing the sad and hopeless type of video we usually see. Individually, they will then compare and evaluate all the different solutions amongst their classmates and present it in the format of their choice (report, poster, powerpoint, video, podcast, etc.).

3-Dimensional Assessment

Disciplinary Core Ideas

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.

ESS3.D: Global Climate Change
- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming).

LS1.B: Growth and Development of Organisms
- Animals engage in characteristic behaviors that increase the odds of reproduction.
- Plants have specialized features for reproduction and sometimes depend on animal behavior to reproduce.

ESS3.C: Human Impacts on Earth Systems
- Human activities have significantly altered the biosphere and changing Earth's environments can have different impacts for different living things. As human population and consumption of natural resources increases, so do these impacts, unless the activities and technologies involved are engineered otherwise.

ETS1.B: Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

Science and Engineering Practices

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.

Designing Solutions
- Apply scientific ideas or principles to design an object, tool, process, or system.

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.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Crosscutting Concepts

Cause and Effect
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Stability and Change
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

*As compared to the other three units, Unit 4 is unique in that it introduces two PEs (MS-ESS3-3 and MS-ETS1-2) in the final project only and not during the tasks themselves. These PEs will be easier for students to engage with in the full context of the project.

6th Grade Science Unit 4: A Warmer World
Culminating Project

Time Needed (Based on 45-Minute Periods)

10 days at end of unit

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

Materials

Advocacy Video

- Recording Device (phone, computer, camera, etc.)
- Movie Editing Software (Optional)
- Poster Paper (Optional for visuals)
- Color pencils/markers or computer graphics (Optional for Visuals)

Solutions Evaluation

- Depends on choice in format

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 the 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.

3. We have provided a list of organisms that students may choose from in the Culminating Project Task Card. At the end of this Teacher Version, we also provide a table that gives you relevant information on each organism, sources you may wish to give students as they conduct their own research, and some potential solutions students may come up with.

4. Remind students as they complete the Project Organizer that they will be planning pieces of their advocacy video 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 develop their advocacy video or solutions evaluation until the end of the unit, so change during the imaginative and creative time is acceptable and often experienced.

5. Make sure the students fill out the Project Organizer after each task, which will help the students think about different parts of their advocacy video or solutions evaluation 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. 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. The one exception to this is for Task 1; at this point, students will need to work as a group to select an organism for their Culminating Project.

6. The table below summarizes how the Project Organizer guides the students through developing different components of their advocacy video (group product) and solutions evaluation (individual product).

Task	Project Organizer	Group and Individual Culminating Project
Lift Off Bad News for Bees	• Make a hypothesis: What do you think is causing the bee population to decrease? • Do you think other organisms around the world might also be affected by the same cause? How?	N/A
Task 1 Heating Up	Select an organism for your culminating project. • Define the **problem**: What is happening to global temperature and why might it be a problem? • Identify the **criteria** for a successful solution: How will you know if a solution addresses the problem? • Identify the **constraints** of solving this problem: What might make it hard to solve this problem?	• Group: A description of the problem, including criteria and constraints. • Individual: A description of the problem, including criteria and constraints. Description cites global warming as the root of the problem, including evidence to support this claim.
Task 2 It Takes Two	• What specialized structures OR behaviors does your organism have that help it survive and reproduce? Describe how these characteristics specifically help with survival and/or reproduction?	• Group: N/A • Individual: An argument for how all the presented organisms' behaviors or structures affect their probability for successful reproduction, supported by evidence.
Task 3 Feeling the Impact	• 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?	• Group: A description of the problem, including how the chosen organism is affected. An explanation of a method to monitor or minimize the impact on the organism. • Individual: An argument for how the reproductive behaviors or structures are being affected by rising temperatures, supported by evidence.

7. After all the learning tasks and the Project Organizer are completed, the students can start to develop their advocacy video. The Project Organizers and Group Project Criteria for Success should be used as reference to remind students to include all the components of their advocacy video.
    - 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.

8. While groups are presenting their videos, we highly recommend students take notes about the videos since they will be evaluating them in their individual project. You may choose to provide them with a graphic organizer to organize their notes. An option is provided at the end of this Teacher Version.

9. Once students have taken notes on all the videos, they are ready to move on to their individual project. Each student will compare and evaluate the different solutions amongst the groups. This can be in the format of their choice but it must meet all the criteria in the student handout. Because students can choose a variety of formats, no optional template is provided. Remind students to reference the *Individual Project Criteria for Success* as they create their Solutions Evaluation.
    - Optional: Before students begin their evaluation, you may want to have a class discussion to come to consensus on the criteria and constraints for the human impact problem facing all these organisms. Ask students to consider what they think would make a solution successful and what limitations might constrain a solution.

10. Conduct a peer review of the Solutions Evaluation after students have completed a first draft.
    - Copy the Solutions Evaluation 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.

11. 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.

- 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 4: A Warmer World

Culminating Project

Organism	Characteristic that Helps Reproduction	How This Is Affected By Global Warming	Optional Source	Potential Solutions
Magpie Larks	Nesting – Magpie Larks use mud and grass to make nests in trees in order to protect their eggs.	Rising temperatures and decreased rainfall associated with global warming are reducing the availability of mud available to make their nests. Without mud, Magpie Larks are unable to protect their offspring.	• https://www.bou.org.uk/mainwaring-climate-change-nests/	• Irrigate the drier areas with water from wetter locations to increase the amount of mud available.
Shorebirds	Nesting – Shorebirds build their nests on shore.	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.	• https://www.birdwatchingdaily.com/news/conservation/increase-shorebird-nest-predation-climate-change/	• Construct birdhouses that keep eggs safe inside, but still have narrow openings to allow adults in and out to feed offspring. • Construct protected habitats with fences to keep out predators.
Finnish Birds	Nesting – Finnish Birds build their nests on arable (farm) land.	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.	• https://www.sciencedaily.com/releases/2018/01/180111100848.htm	• Designate a certain percentage of protected land to remain unplowed. • Build a nest-detecting device to attach to the farmers' tractors.
Salmon	Migration – Salmon migrate from the ocean upstream into rivers to find a suitable spot to lay eggs.	Salmon are migrating and spawning earlier because of the warmer temperatures. The changing conditions can make growth and survival more difficult	• https://blogs.ei.columbia.edu/2015/02/03/climate-change-poses-challenges-to-plants-and-animals/	• Build a device to help regulate river water temperatures in spawning pools. • Build a device that detects spawning and releases food into

		when the babies are born, or migrating animals arrive before their food is available. Global warming is also causing either less river water so it is hard for salmon to migrate, or it is causing extreme storms that wash out spawning locations.	• https://www.worldwildlife.org/stories/sockeye-salmon-and-climate-change	river near spawning areas. • Transporting water from wetter locations for water storage. • Construct dams to hold back excess water during extreme weather events.
Whooping Cranes	Migration – Whooping Cranes migrate north during the spring for better nest locations with an abundance of food.	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.	• https://phys.org/news/2017-09-climate-affecting-whooping-cranes-migration.html	• Construct and strategically place birdhouses for early migrators.
Hummingbird	Migration – Hummingbirds migrate to breeding grounds during peak flower blooms to have plenty of nectar (food) for their offspring.	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 for adequate food for their offspring.	• https://www.audubon.org/conservation/how-climate-change-affects-hummingbirds-feeding-behavior • https://www.climatecentral.org/gallery/graphics/climate-change-risk-to-hummingbirds • https://bioone.org/journals/natural-areas-journal/volume-34/issue-2/043.034.0213/Timing-is-	• Construct and strategically place birdhouses with food inside for late migrators.

			Everything--An-Overview-of-Phenological-Changes-to/10.3375/043.034.0213.full	
Caribou	Migration – Caribou migrate south for breeding where there is an abundance of food.	Spring plant growth is now earlier because of warming temperatures. This is happening well before calving, so many calves are dying without adequate food available at the breeding site.	• https://www.seattletimes.com/seattle-news/environment/5-plants-and-animals-utterly-confused-by-climate-change/	• Harvesting and storing food for later caribou migration. • Developing a planting protocol that ensures plant growth later in the Spring. • Genetically engineer plants to grow later in the spring.
Spider Orchid	Sex Pheromones and Bright Flowers – The Spider Orchid mimics female bees by having bright flowers that look like a bee and releasing a sex pheromone.	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.	• https://www.theguardian.com/environment/2018/apr/05/climate-change-threatens-rare-british-orchid-that-tricks-bees-into-mating • https://www.theguardian.com/environment/2014/nov/06/climate-change-is-disrupting-flower-pollination-research-shows	• Introducing other insects that can pollinate the Spider Orchid. • Artificial Pollination.
Lilac	Bright Flowers – The Lilac attracts pollinators with its bright flowers.	Warming temperatures are causing Lilacs to bloom earlier. The insects that eat them are thus plentiful earlier, so by the time birds arrive for breeding season, there are not enough insects for	• https://www.thoughtco.com/spring-phenology-and-global-climate-change-1203890	• Construct and strategically place birdhouses with food inside for migrators. • Developing a planting protocol that ensures lilac growth later in the Spring. • Genetically engineer lilacs to

		the birds to eat.		grow later in the spring.
Glacier Lily	Bright Flowers: The Glacier Lily has bright flowers to attract hummingbirds.	Warming temperatures are causing Glacier Lilies to bloom earlier, before the hummingbirds arrive. This affects pollination for the Glacier Lily and a food source for the hummingbird.	• https://www.aaas.org/hummingbirds-lilies-thrown-climate-change • https://bioone.org/journals/natural-areas-journal/volume-34/issue-2/043.034.0213/Timing-is-Everything--An-Overview-of-Phenological-Changes-to/10.3375/043.034.0213.full	• Artificial Pollination for the Glacier Lily. • Construct and strategically place birdhouses with food inside for hummingbirds.

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Culminating Project

Advocacy Video Notetaker

	Organism	Notes	How well does the solution meet the criteria and constraints of the problem? Could this solution work for my organism?
1			
2			
3			

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Culminating Project

	Organism	Notes	How well does the solution meet the criteria and constraints of the problem?
4			
5			
6			

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Culminating Project

	Organism	Notes	How well does the solution meet the criteria and constraints of the problem?
7			
8			
9			

6th Grade Science Unit 4: A Warmer World
3-Dimensional Individual Project Rubric

Overview: The following rubrics can be used to assess the individual project: an evaluation of different solutions to minimize human impact on organisms. 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	✓ A description of the problem facing all organisms, including: ○ The criteria and constraints for solving this problem for all organisms	**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.	**N/A**
2	✓ Scientific background to help your audience understand the problem, including: ○ The cause of the problem and the evidence that supports this cause-and-effect relationship ○ Whether you think this problem was caused by a sudden change or gradual changes that have accumulated over time and why	**N/A**	**ESS3.D: Global Climate Change** ● Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	**Stability and Change** ● Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

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3-Dimensional Individual Project Rubric

3	✓ An argument for why global warming poses a threat to organisms, including ○ 1) How all the organisms' behaviors or structures affect their probability for successful reproduction ○ Describe examples from other group's projects as evidence	**Engaging in Argument From Evidence** ● Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**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.	**N/A**
4	✓ An argument for why global warming poses a threat to organisms, including ○ 2) How these behaviors or structures are being affected by rising temperatures ○ Describe examples from other group's projects as evidence	**N/A**	**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** ● Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
5	✓ An explanation of your method to monitor or minimize the impact of your plant/animal	**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	**N/A**

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3-Dimensional Individual Project Rubric

			resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	
6	✓ An evaluation of solutions: ○ Which solution do you think will have the most impact (best meets the criteria)? ○ Which solution seems to be the most feasible (best meets the constraints)? ○ Based on your evaluation, which solution would you recommend and why?	**Engaging in Argument From Evidence** ● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	**ETS1.B: Developing Possible Solutions** ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	**N/A**

6th Grade Science Unit 4: A Warmer World
3-Dimensional Individual Project Rubric

Rubric 1: Student defines the problem of human impact on organisms, including criteria of success and constraints that might limit possible solutions.

- Dimensions Assessed: SEP – Asking Questions and Defining Problems, DCI – ETS1.A: Defining and Delimiting Design Problems

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **does not** define the problem of human impact on organisms **and/or** includes **inaccurate or irrelevant** criteria of success and constraints that might limit possible solutions.	Student **accurately** defines the problem of human impact on organisms, including **accurate** criteria of success **OR** constraints that might limit possible solutions.	Student **accurately** defines the problem of human impact on organisms, including **accurate but partial** criteria of success **and** constraints that might limit possible solutions.	Student **accurately** defines the problem of human impact on organisms, including **accurate and complete** criteria of success **and** constraints that might limit possible solutions.
Look Fors: ● Student does not describe global warming threatening organisms as the problem. ● And/or the student identifies criteria of success and constraints that are inaccurate, irrelevant, or unreasonable. For example, they might identify a criterion of success as reversing global warming so there is a decrease in mean global temperature.	**Look Fors:** ● Student accurately describes that global warming is posing a threat to all the organisms focused on in the projects. ● Student accurately defines the criteria for success OR at least one constraint. See *Advanced Look-Fors* for options.	**Look Fors:** ● Student accurately describes that global warming is posing a threat to all the organisms focused on in the projects. ● Student accurately defines the criteria for success. For example, student explains that maintaining or increasing organism population sizes would indicate a successful solution. ● Student also accurately defines one, but not multiple constraints. See *Advanced Look-Fors* for options.	**Look Fors:** ● Student accurately describes that global warming is posing a threat to all the organisms focused on in the projects. ● Student accurately defines the criteria for success. For example, student explains that maintaining or increasing organism population sizes would indicate a successful solution. ● Student also accurately and completely defines any constraints. For example, unseen consequences of interfering in ecosystems, inability to mimic natural processes, limited amount of resources available, cost, buy-in from consumers, etc.

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3-Dimensional Individual Project Rubric

Rubric 2: Student explains the cause of the problem, including whether it is due to a sudden change or gradual changes that accumulate over time.

- Dimensions Assessed: DCI – ESS3.D: Global Climate Change, CCC – Stability and Change

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **inaccurately** explains the cause of the problem.	Student **accurately but partially** explains the cause of the problem, **and may include** whether it is due to a sudden change or gradual changes that accumulate over time.	Student **accurately and completely** explains the cause of the problem, **but does not include** whether it is due to a sudden change or gradual changes that accumulate over time.	Student **accurately and completely** explains the cause of the problem, including whether it is due to a sudden change or gradual changes that accumulate over time.
Look Fors: • Student inaccurately explains the cause of global warming. For example, student states it is caused by volcanic eruptions. • Student may describe global warming as an accumulation of gradual changes, or may inaccurately describe a sudden change, such as a volcanic eruption.	**Look Fors:** • Student partially explains the cause of global warming. For example, student may reference human activities, such as the burning of fossil fuels OR student may reference an increase in carbon dioxide emissions, but student does not connect the two. • Student may or may not accurately describe global warming as an accumulation of gradual changes.	**Look Fors:** • Student explains that human activities, such as the burning of fossil fuels, are causing an increase in carbon dioxide emissions, which is causing a rise in global temperatures. • Student does not accurately describe that global warming is caused by gradual changes (such as increased burning of fossil fuels) that accumulate over time rather than by a sudden event.	**Look Fors:** • Student explains that human activities, such as the burning of fossil fuels, are causing an increase in carbon dioxide emissions, which is causing a rise in global temperatures. • Student accurately describes that global warming is caused by gradual changes (such as increased burning of fossil fuels) that accumulate over time rather than by a sudden event.

Note: An additional rubric is provided in the Task 1 Teacher Version to the SEP associated with this PE – Asking Questions and Defining Problems.

6th Grade Science Unit 4: A Warmer World
3-Dimensional Individual Project Rubric

Rubric 3: Student argues that there are plant structures and animal behaviors that affect the probability of successful reproduction, supporting with evidence from their own and other groups' projects.

- Dimensions Assessed: SEP – Engaging in Argument From Evidence, DCI – LS1.B: Growth and Development of Organisms

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **accurately** argues that there are plant structures and animal behaviors that affect the probability of successful reproduction, but evidence from their own **or** other groups' projects is **missing or inaccurate**.	Student **accurately** argues that there are plant structures and animal behaviors that affect the probability of successful reproduction, **supporting with general scientific reasoning rather than evidence**.	Student **accurately** argues that there are plant structures and animal behaviors that affect the probability of successful reproduction, supporting with **one source of relevant** evidence from their own **or** other groups' projects.	Student **accurately** argues that there are plant structures and animal behaviors that affect the probability of successful reproduction, supporting with **multiple sources of relevant** evidence from their own **and** other groups' projects.
Look Fors: ● Student makes the accurate claim that there are plant structures and animal behaviors that affect the probability of successful reproduction. ● No evidence from any projects is provided, or student uses an inaccurate piece of evidence. For example, student states that animals need to have bright colors for pollination student makes the inaccurate claim that there are no specific plant structures and animal behaviors that affect the probability of successful reproduction.	**Look Fors:** ● Student makes the accurate claim that there are plant structures and animal behaviors that affect the probability of successful reproduction. ● While no specific examples are given as evidence, they do support their claim with general scientific reasoning. For example, student may generally state that these plant structures and animal behaviors help reproduction by attracting pollinators or helping with new offspring.	**Look Fors:** ● Student makes the accurate claim that there are plant structures and animal behaviors that affect the probability of successful reproduction. ● Student supports their argument by describing one specific example, likely their own organism (e.g. animals that nest or migrate and plants that have bright flowers or sex pheromones). *See the Culminating Project Teacher Version for specific examples of organisms and their behaviors or plant structures.*	**Look Fors:** ● Student makes the accurate claim that there are plant structures and animal behaviors that affect the probability of successful reproduction. ● Student supports their argument by describing multiple specific examples from other groups' projects (e.g. animals that nest or migrate and plants that have bright flowers or sex pheromones). *See the Culminating Project Teacher Version for specific examples of organisms and their behaviors or plant structures.*

6th Grade Science Unit 4: A Warmer World
3-Dimensional Individual Project Rubric

Rubric 4: Student explains that global warming likely causes negative effects on many organisms, supporting with evidence from their own and other groups' projects.

- Dimensions Assessed: DCI – ESS3.C: Human Impacts on Earth Systems, CCC – Cause and Effect

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **accurately** explains that global warming likely causes negative effects on many organisms, but evidence from their own **or** other groups' projects is **missing, inaccurate, or irrelevant**.	Student **accurately** explains that global warming likely causes negative effects on many organisms, supporting with **general scientific reasoning rather than evidence**.	Student **accurately** explains that global warming likely causes negative effects on many organisms, supporting with **one source** of evidence from their own **or** other groups' projects.	Student **accurately** explains that global warming likely causes negative effects on many organisms, supporting with **multiple sources** of evidence from their own **and** other groups' projects.
Look Fors: ● Student accurately explains that global warming is the likely cause behind the negative impacts they are seeing in various organisms in this unit. ● No evidence from any projects is provided, or student uses an inaccurate or irrelevant piece of evidence. For example, student states that one example global warming affecting plants and animals is hummingbirds becoming too hot to fly.	**Look Fors:** ● Student accurately explains that global warming is the likely cause behind the negative impacts they are seeing in various organisms in this unit. ● While no specific examples are given as evidence, they do support their claim with general scientific reasoning. For example, student may generally state that global warming is often creating a mismatch between the timing of flower blooms and the arrival of pollinators and migrating animals.	**Look Fors:** ● Student accurately explains that global warming is the likely cause behind the negative impacts they are seeing in various organisms in this unit. ● Student supports their argument by describing one specific example, likely their own organism. *See the Culminating Project Teacher Version for specific examples of how each organism is affected by global warming.*	**Look Fors:** ● Student accurately explains that global warming is the likely cause behind the negative impacts they are seeing in various organisms in this unit. ● Student supports their argument by describing multiple specific examples from other groups' projects (for example, rising temperatures cause flowers to bloom early, so hummingbirds arrive too late to breeding grounds for adequate food for their offspring). *See the Culminating Project Teacher Version for specific examples of how each organism is affected by global warming.*

6th Grade Science Unit 4: A Warmer World
3-Dimensional Individual Project Rubric

Rubric 5: Student describes their solution to monitor or and minimize human impact on their chosen organism.

- Dimensions Assessed: SEP – Designing Solutions, DCI – ESS3.C: Human Impacts on Earth Systems

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student describes their solution **that does not** monitor or minimize human impact on an organism.	Student describes their solution to monitor and minimize an **irrelevant** human impact on their chosen organism, **which is not related to global warming**.	Student describes their solution to monitor and minimize the **relevant** human impact on their chosen organism, **using partial detail**.	Student describes their solution to monitor and minimize the **relevant** human impact on their chosen organism, **using sufficient detail**.
Look Fors: ● Student describes a solution that does not monitor or minimize the human impact on their chosen organism. For example, student describes a plan to build small wooden houses to protect each Finnish Farm Bird nest. This contributes further to deforestation, which does not minimize global warming overall.	**Look Fors:** ● Student describes a solution that monitors and minimizes the human impact on their chosen organism, but it does not specifically relate to the problem of global warming. For example, student describes a plan to create a protected wildlife area for shorebirds that prevents human hunting of the shorebirds.	**Look Fors:** ● Student partially describes a solution that monitors and minimizes the human impact on their chosen organism, specifically caused by global warming. *See the Culminating Project Teacher Version for more examples.* ● Student is lacking some detail, so there is some ambiguity as to how the solution would work and how exactly it addresses the problem.	**Look Fors:** ● Student describes a solution that monitors and minimizes the human impact on their chosen organism, specifically caused by global warming. For example, student describes a specific plan to irrigate drier areas for the Magpie Lark to increase the amount of mud available during nesting season. *See the Culminating Project Teacher Version for more examples.* ● Student provides sufficient enough detail that the reader can completely understand how the solution would work and how it addresses the problem.

6th Grade Science Unit 4: A Warmer World
3-Dimensional Individual Project Rubric

Rubric 6: Student evaluates different solutions by identifying solutions that best meet the criteria and/or constraints of the problem and providing rationales.

- Dimensions Assessed: SEP – Engaging in Argument From Evidence, DCI – ETS1.B: Developing Possible Solutions

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student evaluates different solutions by identifying **irrelevant** solutions that do not meet the criteria **and** constraints of the problem.	Student evaluates different solutions by identifying **relevant** solutions that best meet the criteria **and** constraints of the problem, but **rationale is missing**.	Student evaluates different solutions by identifying **relevant** solutions that best meet the criteria **and** constraints of the problem and providing **some** rationale.	Student evaluates different solutions by identifying **relevant** solutions that best meet the criteria **and** constraints of the problem and providing **detailed** rationales.
Look Fors: ● Student identifies an irrelevant solution they think will make the most impact. The solution they identify would not logically best meet the criteria of the problem. ● Student identifies an irrelevant solution they think is most feasible. The solution they identify would not logically best meet the constraints of the problem.	**Look Fors:** ● Student identifies a relevant solution they think will make the most impact (meets criteria). No rationale is provided. ● Student identifies a relevant solution they think is most feasible (meets constraints). No rationale is provided. ● Identification of solutions will vary depending on the solutions that groups come up with. Student may also choose one solution they feel best meets the criteria and constraints.	**Look Fors:** ● Student identifies a relevant solution they think will make the most impact (meets criteria). Student writes a rationale for their choice that leaves some ambiguity about why the solution best meets the criteria. ● Student identifies a relevant solution they think is most feasible (meets constraints). Student writes a rationale for their choice that leaves some ambiguity about why the solution best meets the constraints. ● Identification of solutions will vary depending on the solutions that groups come up with and the reasoning individual students use in their evaluation. Student may also choose one solution they feel best meets the criteria and constraints.	**Look Fors:** ● Student identifies a relevant solution they think will make the most impact (meets criteria). Student writes a detailed rationale for their choice. ● Student identifies a relevant solution they think is most feasible (meets constraints). Student writes a detailed rationale for their choice. ● Identification of solutions will vary depending on the solutions that groups come up with and the reasoning individual students use in their evaluation. Student may also choose one solution they feel best meets the criteria and constraints.

6th Grade Science Unit 4: A Warmer World
Project Organizer

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

You have been asked to create an advocacy video that describes the human impact on an organism and gives a potential solution. 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 three 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.

Lift-Off Task: Bad News for Bees	Based on your discussion in groups today, ❑ Make a hypothesis: What do you think is causing the bee population to decrease? ❑ Do you think other organisms around the world might also be affected by the same cause? How?
Task 1: Heating Up	You have been provided with a list of organisms that are affected by rising temperatures. As a group, select an organism from the list to focus on for your culminating project and research your organism. Then individually, ❒ Define the **problem**: What is happening to global temperature and why might it be a problem? ❒ Identify the **criteria** for a successful solution: How will you know if a solution addresses the problem? ❒ Identify the **constraints** of solving this problem: What might make it hard to solve this problem?

6th Grade Science Unit 4: A Warmer World

Project Organizer

Task 2: It Takes Two	Consider your chosen organism and do additional research, as necessary: ❒ What specialized structures OR behaviors does your organism have that help it survive and reproduce? Describe how these characteristics specifically help with survival and/or reproduction.
Task 3: Feeling the Impact	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?

6th Grade Science Unit 4: A Warmer World
Lift-Off Task: Bad News for Bees

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

Introduction

In the last unit, students learned about how algae are being affected by human-caused environmental changes—excess fertilizer runoff and changing weather conditions associated with climate change. In this Lift-Off Task, students are introduced to another organism that is affected by human-caused environmental change—bees. After looking at an infographic showing bee population data, students begin to generate questions that might help them better make sense of what is happening to the bee population. These questions will guide students throughout the unit as they continue to make sense of the declining bee population, its cause and effects, and what can be done to address the issue.

Alignment Table

Crosscutting Concept (*depending upon student-generated questions) ● Cause and Effect ○ Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. ● Stability and Change ○ Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
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 the declining bee population so they can begin generating questions to guide them through the unit. More specifically, the purpose is to:

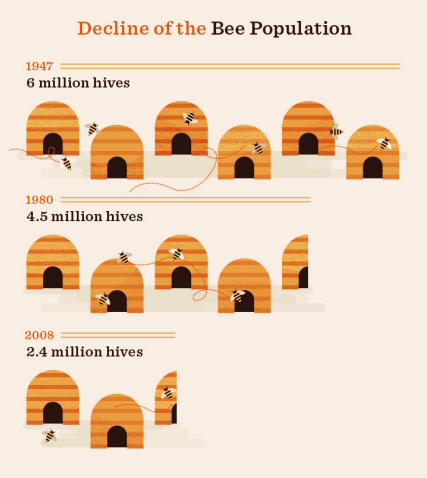
- Individually generate a list of questions about the bee population, using observations from the data shown in the infographic.
- Make connections between related questions.
- Generate possible answers to questions using prior knowledge.
- Use prior knowledge to hypothesize what might be causing the declining bee population and whether other organisms around the world might be affected similarly.

Content Background for Teachers

This task introduces students to the phenomenon of declining bee populations. In 2015, a United Nations group found that populations are declining for 37% of bee species, with 9% of butterfly and bee populations facing extinction. The main causes are the use of pesticides in industrial agriculture and global warming. Warming global temperatures pose a threat in the form of habitat loss by affecting the range of temperature required for a functional hive. Rising temperatures are also causing flowering plants to bloom earlier in the spring, thus putting

6th Grade Science Unit 4: A Warmer World

Lift-Off Task: Bad News for Bees



bees out of sync with the flowering plants they normally pollinate. Because bees are a major pollinator, this poses a large concern for all ecosystems since a lack of pollination may lead to a drastic decrease in plant populations.

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. At this point, students will likely add only predictions about cause-and-effect relationships related to the bee population. As students learn more about the role of global warming and its impact on different organisms, 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

- Organism
- Bee
- Population
- Decline
- Hive
- Advocacy
- Human Impact

*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 4, Lift-Off Task Student Version

Part B

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

Part C

- Class Poster Paper and markers
- *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

6th Grade Science Unit 4: A Warmer World

Lift-Off Task: Bad News for Bees

Instructions

1. Introduce students to the unit by reading or projecting the Unit Essential Question aloud.

2. Organisms around the world are suffering from human-caused environmental changes. In this task, students are introduced to one example—the changing bee population.

3. First, have students look at the infographic in their Student Guides so they can make observations about the bee population data.

Part A

1. In this section of the task, students will generate questions to help them make sense of the phenomenon—the declining bee population. Using these self-generated questions throughout the unit will help students develop a better understanding of the declining bee population, including the causes and associated effects.

2. Have students complete this section individually in their student guide.
    - For students who need more support, encourage them to look back at the data, and consider any questions they have. They might also think back to the phenomenon of the algal blooms from Unit 3.
    - Here is a list of some potential questions students might generate: "Why is the bee population declining? Does this data show a large decline or is this a relatively small decline in population? Why is it bad if bees are dying? Why does this matter? What effect do bees have on their ecosystems? How is the decline of the bee population similar to algal blooms? How might other organisms be affected by the same thing that is killing off bees? Is something eating the bees? What about animals that eat the bees, are they declining too?"

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).

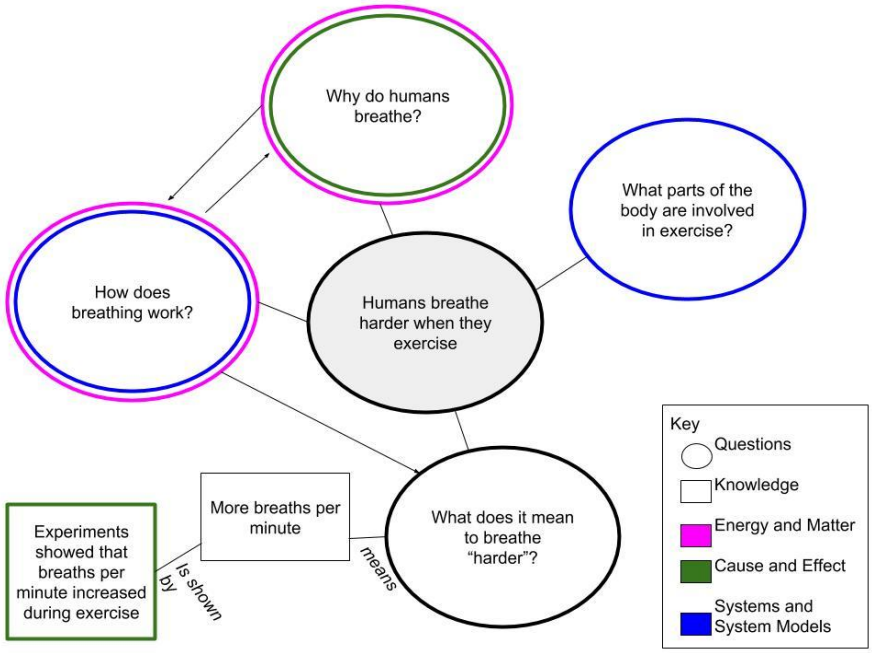
2. Students will post their posters on a wall and then walk around and look at each group's ideas. One suggestion for gallery walks is for students to interact with the posters in some way. For example, students are required to initial or leave post-its on three questions that they are also excited about on other posters.

6th Grade Science Unit 4: A Warmer World

Lift-Off Task: Bad News for Bees

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 4: A Warmer World

Lift-Off Task: Bad News for Bees

Part C

1. Construct a whole-class concept map that begins to help students make sense of the phenomenon of the decline of the bee population.
    - 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** and **Stability and Change**. 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 one.
    - 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.
- **Stability and Change**: These could be phrases such as, "remains the same", "is changed by", "is disrupted by", "changes", "disrupts," 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.

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 asked to create an advocacy video that describes the human impact on an organism and gives a potential solution. The student prompt is as follows: Based on your discussion in groups today,
     - ✓ Make a hypothesis: What do you think is causing the bee population to decrease?
     - ✓ Do you think other organisms around the world might also be affected by the same cause? How?

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 the declining bee population. Look back at your list: think about the questions your peers asked that you did not initially write down. How are their questions different from the ones you originally asked?
   - In this unit, we will be focusing on two crosscutting concepts: **Cause and Effect**: Phenomena may have more than one cause, and sometimes relationships can only be described using probability; **Stability and Change**: Stability might be disturbed by sudden events or the accumulation of gradual changes. Looking at your class concept map, give one example of how one of these crosscutting concepts came up in today's task.
   - 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 4: A Warmer World

Task 1: Heating Up

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

Introduction

In the Lift-Off task, students learned that the bee population is declining. In the last unit, students also learned that algal blooms have been on the rise in recent years. While the effects are different, the same root cause is at play in both cases. In this task, students explore the rise in global temperatures over the past century, including why they are on the rise and predicting how this affects Earth. By introducing one piece of data at a time, students have an opportunity to process the evidence and use it to generate their own questions that drive further learning. By the end of this task, students will be able to explain global warming and use this new knowledge to define the problem facing their chosen organism for their culminating project.

Alignment Table

Performance Expectations	Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]	**Asking Questions and Defining Problems** • Ask questions to identify and clarify evidence of an argument.	**ESS3.D: Global Climate Change** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	**Stability and Change** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

6th Grade Science Unit 4: A Warmer World

Task 1: Heating Up

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**

Supplementary Science and Engineering Practices

- Analyzing and Interpreting Data
  - Analyze and interpret data to provide evidence for phenomena.

Supplementary Crosscutting Concepts

- Patterns
  - Patterns can be used to identify cause and effect relationships.

Equity and Groupwork

- Participate in group roles to analyze evidence and generate questions related to global temperature change.
- Share ideas with a partner.
- Come to consensus on selecting an organism for your culminating project.

Language

- Use mathematical language in written analysis of graphs.
- Represent cause and effect relationships in a flowchart.

Learning Goals

This learning task asks students to ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. More specifically, the purpose is to:

- Engage prior knowledge of global warming in order to make predictions.
- Explore data related to global warming and generate questions to guide further inquiry.
- Explain the cause and effect relationships to describe global warming.
- Emphasize the crosscutting concept of Stability and Change in analysis of carbon emissions data.
- Apply knowledge of global warming to define the problem a specific organism is facing.

6th Grade Science Unit 4: A Warmer World

Task 1: Heating Up

Content Background for Teachers

In this task, students explore the rise in global temperatures over the past century, also known as global warming. Though this warming trend has been occurring for a long time, its pace has significantly increased in the last century due to human activities—mainly the burning of fossil fuels. Fossil fuels include coal, oil, and natural gas, which are burned for various industrial and residential purposes, such as heating and cooking. Because the human population has also drastically increased, this has further increased the burning of fossil fuels.

Burning fossil fuels creates "Greenhouse Gases" in our atmosphere, which causes what is known as the "Greenhouse Effect". The Greenhouse Effect is when the sun's light is absorbed by the Earth and radiated back out towards the atmosphere as thermal energy. The Greenhouse Gases (ie. carbon dioxide and methane from burning fossil fuels) then trap the heat in the atmosphere, causing an increase in the average global temperature.

Global warming causes another issue, known as climate change, which refers to the changes in weather patterns caused by global warming (for example, extreme storms, flooding, etc.). While these terms are often used interchangeably, they are actually different phenomena. In this task, students will be focused on global warming.

You can find all relevant data related to global warming in the *Explore* Station Cards, including graphs and a video of a carbon dioxide and temperature experiment.

Academic Vocabulary

- Global Temperature
- Carbon Dioxide
- Carbon Emissions
- Fossil Fuels
- Volcanic Eruptions
- Problem
- Criteria
- Constraints

Time Needed (Based on 45-Minute Periods)

4 Days

- Engage: 0.5 period
- Explore: 1.5 periods
- Explain: 0.5 period
- Elaborate: 0.5 period
- Evaluate and Reflection: 1 period

Materials

- Unit 4, Task 1 Student Version

Engage

- Projector and Speakers

Explore (Per group)

6th Grade Science Unit 4: A Warmer World

Task 1: Heating Up

- Evidence Cards #1-5
- Computer or Tablet (for video)

Evaluate

- Project Organizer Handout
- Culminating Project Document (for list of organism options)
- Computers or Tablets for Research

Instructions

Engage

1. Introduce Task 1: In the Lift-Off task, you saw that the bee population is declining. 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: In the last unit, you learned that algal blooms have been on the rise in recent years. But why are these things happening? Why are we seeing changes like these in many different organisms around the world? To answer these questions, we first need to investigate how environments are changing around the world and why.
    - Now pass out their Task 1 student guide.

3. Show the first minute of the following video to introduce students to global temperature rise: https://climate.nasa.gov/climate_resources/42/video-temperature-puzzle/.
    - Optional - For more recent news coverage on global warming, show the first 30 seconds of either of the following clips: https://www.youtube.com/watch?v=RvaCM1TNBBk or https://www.youtube.com/watch?v=F-IgOWwzIL4

4. Then have students individually make hypotheses to the following questions: What do you think is causing these rising temperatures? Why do you think rising temperatures might affect organisms?
    - Students will be exploring the first question throughout this task. The second question will remain a hypothesis throughout this task, but students will get more information on impact to organisms through their own project research and in Task 3. Therefore, it is not essential that students generate or are given a definitive answer for the second question during this task. We include this question here to help students understand the storyline of the overall unit.
    - Because these are hypotheses, any responses are valid.

5. Once students have their hypotheses, they record any questions they would want to ask in order to find out more about rising global temperatures. This begins their practice of **Asking Questions**, which is the SEP focused on in this task.

6. We highly recommend students share both their hypotheses and questions in pairs. It is also helpful to share some of these out in a class-wide discussion so both you and your students can get an idea of where students' thinking is.
    - 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. Now that students have made hypotheses, they are ready to gather evidence to see whether global temperatures are actually rising, and if so, why.
    - In alignment with the SEP for this task, **Asking Questions**, students will be given one piece of evidence at a time, so that they may generate their own questions to further their learning.
    - As students analyze each piece of evidence, they are also engaging in the supplementary SEP of **Analyzing and Interpreting Data** to provide evidence of the phenomenon of global warming.

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 and read 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 analysis and questions in their Student Guide.

3. Distribute one piece of evidence to each group at a time, in sequential order. They are placed in a particular order to encourage students to ask certain questions that might guide them towards the next piece of evidence. A sample evidence chart is provided below:

Evidence	What does the evidence tell you?	What additional questions do you have?
Graph: Global Temperature Change	*It shows me that global temperature change is caused by both natural and human causes, not just natural causes.*	*What counts as a natural cause? What counts as a human cause?*
Graph: Temperature and Carbon Dioxide	*This graph shows me that temperature and carbon dioxide are related. When carbon dioxide goes up, so does temperature. It also shows me that there has been a lot more carbon dioxide and a sharper increase in temperature recently.*	*Why are carbon dioxide and temperature related? What is actually making carbon dioxide increase so much recently?*
Experiment: Temperature and Carbon Dioxide	*Methane and carbon dioxide are both causes of temperature increases in greenhouses. This means that they are also causes of global warming.*	*What causes more methane and carbon dioxide in the atmosphere? Does methane or carbon dioxide contribute more to global warming?*
Graph: Carbon	*It shows me that carbon dioxide caused by the burning of fossil fuels has increased a lot*	*When do humans use fossil fuels? Does all carbon dioxide come from fossil fuels or other*

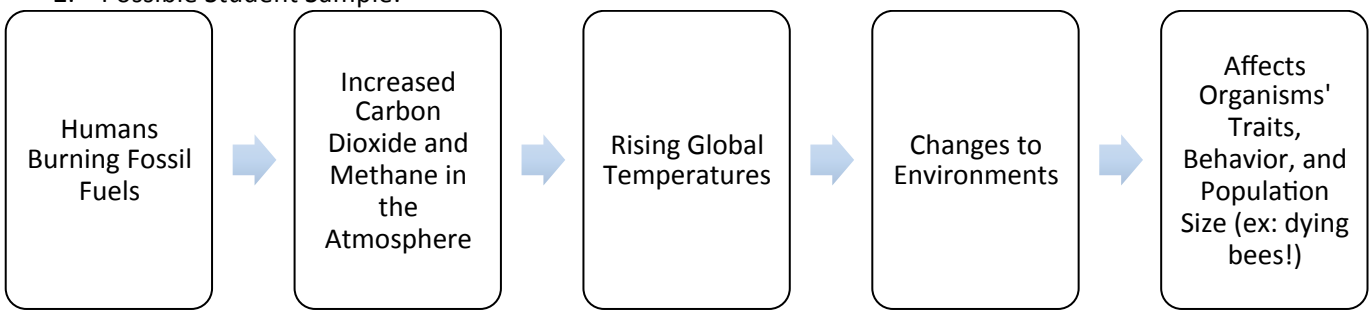
Emissions From Fossil Fuels	*in the last 70 years. Fossil fuels are fuels made from natural resources like coal, natural gas, and oil.*	*places?*
Graph: Carbon Emissions From Volcanic Eruptions	*It shows that carbon dioxide levels in the atmosphere don't actually change much when different volcanic eruptions happen. They have been increasing steadily regardless of a few different eruptions.*	*What else could carbon dioxide come from besides fossil fuels and volcanic eruptions? But what if it's like a REALLY big volcano, like mass extinction big?* Note: Student may have no additional questions for this graph.

- Optional: Do a quick check of students' evidence charts and ask a few facilitating questions as a check for understanding before distributing the next evidence card to a group.
- Note: The last column of this evidence chart can be used to summatively assess the SEP of Asking Questions. See the end of this Teacher Guide for a rubric.

Explain

1. Now that students have seen all the evidence, they can return to the original questions from the Engage: What do they think is causing these rising temperatures? Why do they think rising temperatures might affect organisms? To illustrate their answers to these questions, they individually fill out a cause and effect flowchart, using as many or as few of the boxes they would like to.
   - This activity emphasizes the supplementary CCC of **Patterns**, as students use the patterns from the *Explore* data to identify cause and effect relationships in their flowchart.
   - As stated in the *Engage*, the second question (Why do they think rising temperatures might affect organisms?), and thus the last few boxes of their flowchart will still be hypotheses at this time. Students will learn more about impacts to organisms in their own project research and within Task 3. We recommend you make this explicit to students.

2. Possible Student Sample:



3. Once students complete their flowchart, have them annotate the arrows of their cause-and-effect flowchart with the source of evidence that led them to make the connection.
   - Because the last few boxes will still just be hypotheses based on prior knowledge, encourage students to think about what information they will still need to confidently fill out this flowchart. This continues the same kind of thinking associated with the SEP of **Asking Questions**.

4. The completed flowchart is a good option for formative assessment. Collect student work to identify trends in students' ability to accurately describe global warming. See "How to Use This Curriculum" for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.

Elaborate

1. To emphasize the CCC for this task, **Stability and Change**, students will return to two pieces of evidence from the *Explore*—both graphs about the causes of carbon dioxide emissions.

2. In partners, students discuss the following questions:
    - 1) Which one represents a sudden change? Which one represents gradual changes that have accumulated over time? Explain how you know.
        i. This question explicitly addresses **Stability and Change** as students consider how stability can be disturbed either by sudden events (volcanic eruptions) or gradual changes that accumulate over time (burning of fossil fuels).
    - 2) Which cause seems to have more of an impact over time?
        i. This second question aims to emphasize that it is the gradual accumulation of carbon dioxide associated with burning fossil fuels that has the most effect. Thus, human impact, not natural causes, is to blame for global warming.

3. This section can also serve as a good option for formative assessment. Collect student work to identify trends in students' ability to accurately describe the main cause of global warming, using the concept of **Stability and Change**. See "How to Use This Curriculum" for strategies on utilizing formative assessment data to provide feedback to students and inform classroom instruction.
    - You may also want to share out a few student responses in a class-wide discussion to get a sense of students' understanding at this point in the task.

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: rising global temperatures, the cause of these rising temperatures, and potential impacts to organisms.
    - 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:
    - **Stability and Change**: These could be phrases such as, "remains the same", "is changed by", "is disrupted by", "changes", "disrupts," 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 1 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: You have been provided with a list of organisms that are affected by rising temperatures. As a group, select an organism from the list to focus on for your culminating project and research your organism. Then individually,
    - ✓ Define the **problem**: What is happening to global temperature and why might it be a problem?
    - ✓ Identify the **criteria** for a successful solution: How will you know if a solution addresses the problem?
    - ✓ Identify the **constraints** of solving this problem: What might make it hard to solve this problem?

3. Based on prior knowledge and research, students should be able to describe that global warming changes environments in a way that might affect organisms (their traits, behavior, population size, etc.). One essential criterion for success is for their solution to ensure that no further harm impacts their chosen organism. Constraints might include: time, money, resources, buy-in from communities, natural constraints, etc.
    - This Evaluate emphasizes the PE, MS-ETS1-1, as students 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 hypothesize why temperatures are rising. Look at your hypotheses in the *Engage* and your flowchart in the *Explain*. How has your understanding changed over the course of the task?
    - In this task, we focused on the crosscutting concept of **Stability and Change**: Stability might be disturbed by sudden events or the accumulation of gradual changes. Where did you see examples of **Stability and Change** in this task?
    - Now that you have learned more about the rise of global temperatures and its cause, 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 1 Student Versions and assess the *Explore* using the 3-Dimensional Task 1 Rubric below. To maintain the authenticity of the Culminating Project, the SEP of Asking Questions will be assessed through this task rather than within the Culminating Project. The other dimensions of MS-ESS3-5 will be assessed 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 4: A Warmer World

Task 1: Heating Up

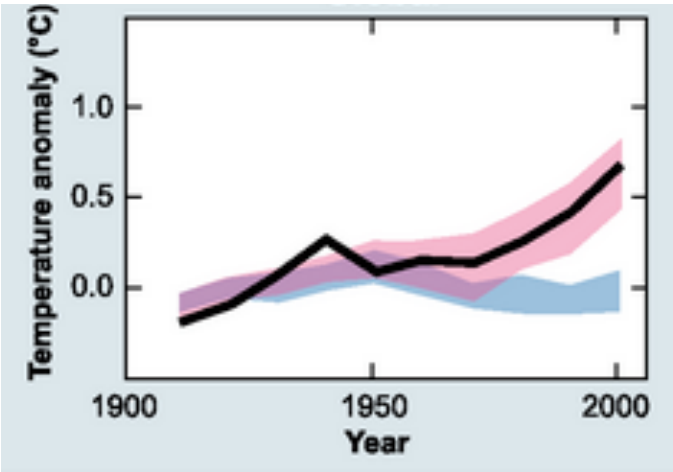
Task 1 Rubric: Student asks questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

- Dimensions Assessed: SEP – Asking Questions, DCI – ESS3-D: Global Climate Change

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student asks **irrelevant** questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Student asks **some relevant** questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Student asks **mostly relevant** questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Student asks **all relevant** questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
Look Fors: ● For all pieces of evidence (#1-4), student asks questions that are irrelevant to the piece of evidence they correspond with and/or that don't drive further inquiry into the cause of rising global temperatures.	**Look Fors:** ● For at least one out of four pieces of evidence, student asks questions that are relevant to the piece of evidence they correspond with and that also drive further inquiry into the cause of rising global temperatures. ● See last column of student sample in *Explore* for examples of relevant questions.	**Look Fors:** ● For three out of four pieces of evidence, student asks questions that are relevant to the piece of evidence they correspond with and that also drive further inquiry into the cause of rising global temperatures. ● See last column of student sample in *Explore* for examples of relevant questions.	**Look Fors:** ● For each piece of evidence (#1-4), student asks questions that are all relevant to the piece of evidence they correspond with and that also drive further inquiry into the cause of rising global temperatures. ● See last column of student sample in *Explore* for examples of relevant questions.

Graph: Global Temperature Change

Evidence 1



http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-9-2-figure-1.html

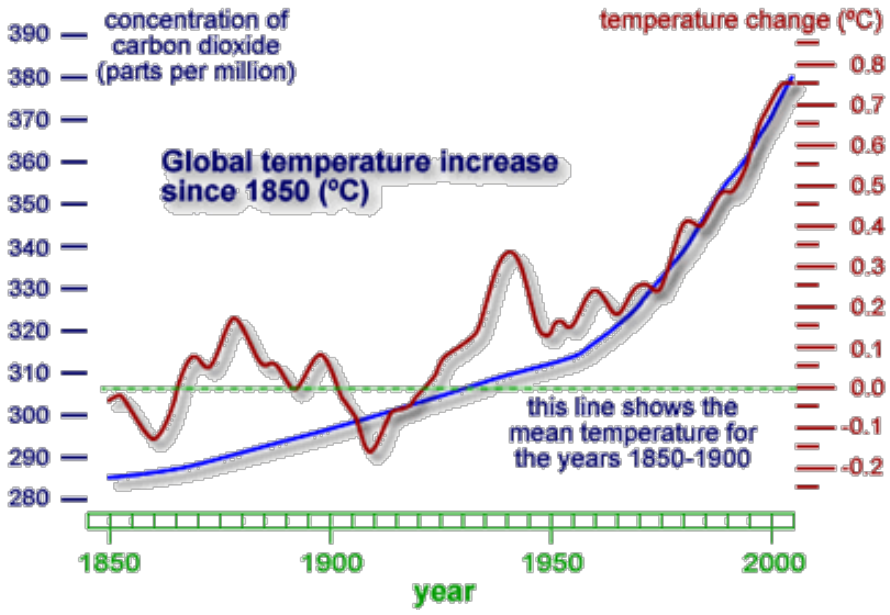
Expected temperature change if only natural causes

Expected temperature change if both natural and human causes

Actual temperature change

Graph: Temperature and Carbon Dioxide

Evidence 2



http://www.stormlake.org/542/Carbon-Sinks-and-Cycles

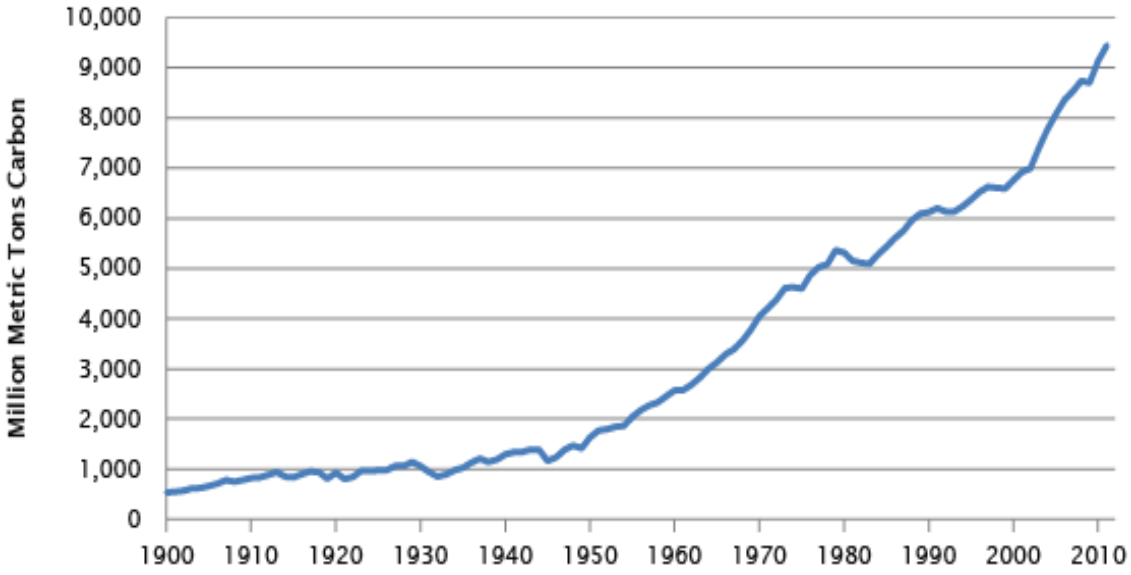
Experiment: Temperature and Carbon Dioxide

Evidence 3

Watch the following mythbusters video to see the experiment:
https://www.youtube.com/watch?v=pPRd5GT0v0I

Graph: Carbon Emissions From Fossil Fuels

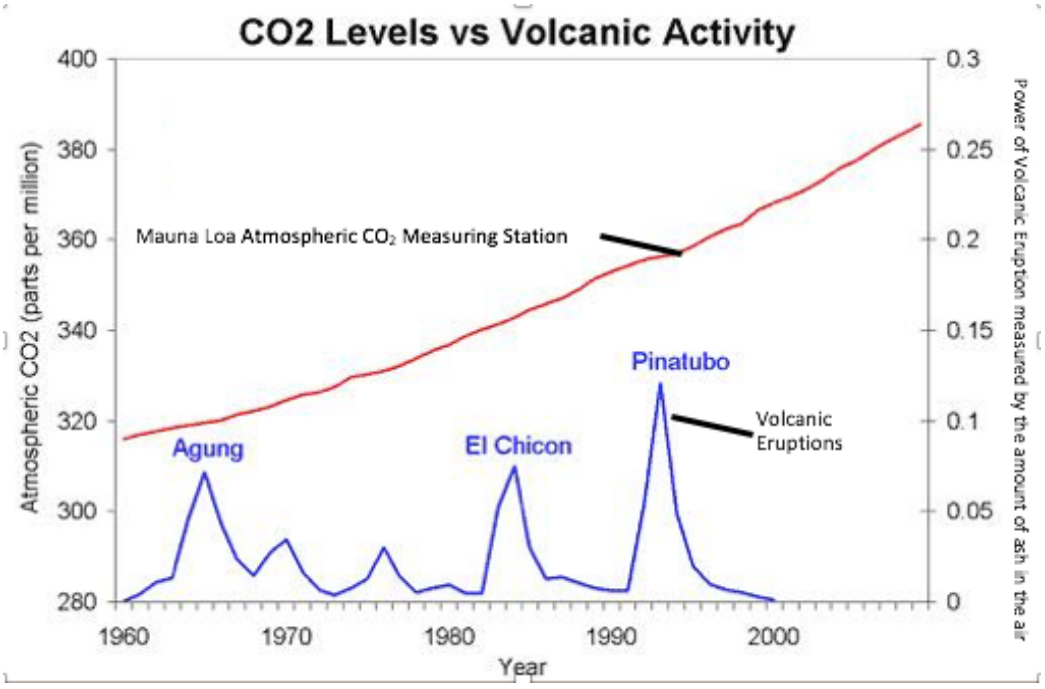
Evidence 4



”Carbon Emissions” refer to the carbon dioxide released into the atmosphere
“Fossil Fuels” are fuels made from a natural resource like coal, oil, and natural gas

Graph: Carbon Emissions From Volcanic Eruptions

Evidence 5



*"Carbon Emissions" refer to the carbon dioxide released into the atmosphere

6th Grade Science Unit 4: A Warmer World

Task 2: It Takes Two

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

Introduction

In the last task, students saw evidence that global temperatures have been rising in the past century due to human activity, like the burning of fossil fuels. They also made hypotheses about how these rising temperatures might affect Earth's environments and various organisms. Before students can explore what rising temperatures means for Earth and its organisms, they need to understand what factors influence survival and reproduction of organisms in the first place. In this task, students will learn about the different animal behaviors and plant structures that help organisms to successfully survive and reproduce. In doing so, they will learn that these characteristics are often interrelated and thus organisms, like bees and flowering plants, rely on each other. This sets the stage for the next task where students learn how these characteristics are negatively impacted by global warming. By the end of this task, students will be able to describe the specialized plant structures or animal behaviors that help their specific organism survive and reproduce.

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	**Engaging in Argument From Evidence** • Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**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.

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Task 2: It Takes Two

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.]			
Equity and Groupwork • Participate in group roles to explore stations. • Discuss *Explore* evidence as a class to build consensus. • Share ideas with a partner.			
Language • Read about new scientific terminology and describe analysis in own words. • Write an argument, using evidence and scientific reasoning.			

Learning Goals

This learning task asks students to write an argument supporting the explanation that characteristic plant structures and animal behaviors affect their probability of survival and reproduction. More specifically, the purpose is to:

- Engage prior knowledge of pollination to try to explain how flowering plants and bees rely on one another.
- Explore examples of animal behaviors and plant structures that affect reproduction.
- Write an argument explaining how flowering plants and bees rely on one another, using evidence from research stations.
- Predict what would happen to plants if the bee population continues to decline.
- Apply task knowledge and conduct research as necessary to describe the specific characteristics that help their chosen organism survive and/or reproduce.

Content Background for Teachers

In this task, students explore plant structures and animal behaviors that help organisms survive and reproduce. While there are many different examples of these characteristics (see PE Clarification Statement), we specifically chose nesting, migration, bright flowers, and sex pheromones because these examples are also currently affected by global warming in the organisms we focus on in this task. These effects will be explored in Task 3. By selecting these particular plant structures and animal behaviors, and the corresponding organisms, we help to ensure a more cohesive storyline connecting this PE to global warming and potential solutions to minimize detrimental human impact.

Each of the plant structures and animal behaviors students explore has some effect on the probability of successful reproduction for those organisms. With the bee and the flowering plant, students will find that often times, animal behaviors play a role in likelihood of successful reproduction in plants, and vice versa. In the next task, students will find that these relationships create a cascade of downstream effects as organisms respond to global warming.

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For information on these specific characteristics, see the *Explore* station cards, as well as the associated sources listed in the Culminating Project Teacher Version.

Academic Vocabulary

- Animal Behavior
- Plant Structure
- Reproduce/Reproduction
- Nesting
- Offspring
- Predators
- Migration
- Habitat
- Abundance
- Breed
- Pollen
- Pollination
- Adapt
- Sex Pheromone
- Mimic

Time Needed (Based on 45-Minute Periods)

4 Days

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

Materials

- Unit 4, Task 2 Student Version

Explore

- Station Cards (1-2 copies per station) – may need to duplicate stations based on class size

Evaluate

- Project Organizer Handout
- Computers or Tablets, if research is necessary

Instructions

Engage

1. Introduce Task 2: In the last task, you saw evidence of rising global temperatures and the factors causing them. 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: Why does a rise in global temperatures matter? What does this mean for Earth and its organisms? Before we can explore these questions, we first need to understand what actually affects the survival of organisms on Earth. In this task, you will explore examples of different behaviors and structures that allow organisms to successfully survive and reproduce.
    - Now pass out their Task 2 student guide.

3. Ask students to recall what they learned in the Lift-Off task and call on a student to share. Students should recall that the bee population is declining.
    - Introduce this task with the following statement: Scientists say that bees and flowering plants heavily rely on each other, so this could be a huge concern.

4. In partners, have students use their prior knowledge about these two organisms to discuss and try to explain what they think scientists mean by this statement. Students should record their thoughts in their Student Guides.
    - Because these are hypotheses, any responses are valid.

5. We highly recommend students share some of these ideas out in a class-wide discussion.
    - 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 explain this statement from scientists, students need more evidence about what animal behaviors and plant structures help organisms, like bees and flowering plants, to survive and reproduce. In groups, students visit stations to gather and record this evidence in the table in their Student Guides.
    - As students explain how each structure or behavior helps survival and/or reproduction, they emphasize the CCC of **Cause and Effect**. While each structure and behavior likely affects reproduction in some way, successful reproduction has several causes, so these cause-and-effect relationships can only be reflected in terms of probability.

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 and read 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 analysis in their Student Guide.

3. You can choose to set up the stations any way you'd like. However, because there are only four stations, we recommend making duplicates of each station, so that each station only has one group present at a time.

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Task 2: It Takes Two

4. A sample evidence table is provided below:

Characteristic	What Organisms Do/Have This?	Explain how this helps survival and/or reproduction.
Nesting *Animal Behavior*	*Shorebird* *Finnish Bird* *Magpie Lark*	*This behavior helps animals reproduce by protecting their offspring from danger when they are vulnerable as eggs. Nests hide eggs from predators and shield them from natural elements so more offspring survive.*
Migration *Animal Behavior*	*Salmon* *Whooping Cranes* *Caribou* *Hummingbirds*	*This behavior helps animals reproduce by helping organisms find better breeding locations. These locations are often safer, have better weather, or more food available for the offspring when they are born. This leads more offspring to survive.*
Bright Flowers *Plant Structure*	*Lilac* *Spider Orchid* *Glacier Lily*	*This plant structure helps plants reproduce because it attracts pollinators, like bees and insects. They land on the flowers to get food, thus picking up the flower's pollen and transferring it to another plant.*
Sex Pheromones *Plant Structure*	*Spider Orchid*	*This plant structure helps plants by attracting the male bee with a scent very similar to a female bee. This causes them to land on the flowers and pick up pollen to transfer to another plant.*

5. After their evidence table, students are given the following discussion question: In what examples did animal behaviors and plant structures seem related? Explain. This question is intended to highlight how animals and plants often rely on each other, which will be emphasized as students explore effects of global warming in Task 3.
    - We recommend having students discuss this question in groups and then share out ideas as a class. This not only provides you with a quick check to gauge student understanding, it also is a good equity practice.

Explain

1. Now that students have seen all the evidence, they can return to *Engage* scenario: Scientists say that bees and flowering plants heavily rely on each other. Individually, students write an argument that supports or refutes this statement, using evidence from the *Explore* stations and scientific reasoning.
    - Here students are using the SEP of **Engaging in Argument From Evidence**, as they write an argument using evidence and scientific reasoning to support an explanation for the bee and flowering plant phenomenon.
    - Students will only be incorporating evidence from the "Bright Flowers" resource, but they may be using at least one of the other resources for their Culminating Project, depending on the organism they choose. This also emphasizes the practice of selecting only the evidence that is pertinent to the question.

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Task 2: It Takes Two

2. Optional Sentence Frames to Provide:
    - I agree/disagree (pick one) with the scientists that say that…
    - Based on what I learned in the stations, I think that…
    - This means that…
    - The bees rely on the flowers for…
    - The flowers rely on the bees for…
    - Other plants and animals seem to have a similar relationship, like…

3. Possible Student Sample: *I agree with the scientists that say that bees and flowering plants heavily rely on each other. Based on my own prior knowledge and the Explore stations, I know that bees are pollinators. This means that they help flowering plants reproduce by moving pollen between flowers as they look for food. The bees rely on the flowers for food (nectar), which they need to survive. The flowers rely on the bees to reproduce, so they can create more offspring. Other plants and animals seem to have a similar relationship, like the hummingbird and glacier lily.*

4. For additional language support, consider using the *Stronger Clearer* as an opportunity for students to share and revise their arguments. A template is provided below:

Use the *Stronger Clearer* protocol below to get feedback for your argument and make revisions.

1. **Individual Think Time:** Turn your student guide over so you can't see it. Take a minute to think about how you will describe your argument to a first partner.

2. **Partner Discussion 1:** You will work in pairs. One of you will be Student A and the other Student B. Student A will start first:
    - **Student A:** Without looking or reading what you wrote down, describe your argument.
    - **Student B:** Listen and ask clarifying questions. Ask questions to help Student A describe their argument. For example, you might ask, "How do you think bees and plants rely on each other?" or "What evidence can you use to support that?"
    - **Both Student A and Student B:** Write down any notes, thoughts, or questions that came up in this discussion.

    Now switch roles and repeat the steps above.

3. **Partner Discussion 2:** Repeat the partnering process with another student. Remember to try to strengthen and clarify your argument. Write down new notes, insights, and questions.

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4. **Partner Discussion 3:** Repeat the partnering process with another student. Remember to try to strengthen and clarify your argument. Write down new notes, insights, and questions.

Revision: After you have worked with partners to clarify your argument, review your notes and go back to revise your argument.

5. The revised argument is a good option for formative assessment. Collect student work to identify trends in students' ability to write an accurate argument supported by evidence and scientific reasoning. 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 know from the Lift-Off task that the bee population is declining. Using what they have just learned, students can make a probable prediction about what they think will happen to plants if the bee population continues to decline.
    - Here, students are again emphasizing the CCC of **Cause and Effect**. Successful survival and reproduction has several causes, so these cause-and-effect relationships related to plant structures and reproduction can only be reflected in terms of probability.

2. Students should discuss and record their prediction and reasoning in partners, but we highly recommend sharing out predictions in a class-wide discussion. This discussion provides a transition towards the next task, as students will be thinking about how global warming affects multiple organisms because of their relationships with each other.

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: plant structures that affect reproduction, animal behaviors that affect reproduction, and relationships between environments, plants, and animals.

- 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 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: Consider your chosen organism and do additional research, as necessary:
   - ✓ What specialized structures OR behaviors does your organism have that help it survive and reproduce? Describe how these characteristics specifically help with survival and/or reproduction.

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 explain what you thought scientists mean when they say plants and bees rely on each other. Look back at your responses in the *Engage* and your argument in the *Explain*. How has your thinking changed or remained the same over the course of this task?
   - 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 characteristics that affect organisms' survival and reproduction, 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 4: A Warmer World

Task 2: It Takes Two

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.

Nesting

Animal Behavior

Some animals build nests to protect their offspring from danger when they are vulnerable as eggs. Most nests are built to hide eggs from predators and shield them from natural elements. Below are some examples:

 **Shorebird's Nest** Built on shore	 **Finnish Bird's Nest** Built on farm land	 **Magpie Lark's Nest** Built in trees, using mud

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Migration

Animal Behavior

Many different animals migrate from one habitat to another for a variety of different reasons. Most often, animals migrate to breed. Below are some examples:

 **Salmon** Migrate from the ocean upstream into rivers to find a suitable spot to lay eggs	 **Whooping Cranes** Migrate north during the spring for better nest locations with an abundance of food	 **Caribou** Migrate inland to give birth to their calves and eat the Arctic plants that grow there	 **Hummingbirds** Migrate to breeding grounds where there is an abundance of flowering plants for food (nectar)

Bright Flowers

Plant Structure

Plants rely on bees and other insects to reproduce. When bees and insects land on flowers to sip nectar for food, pollen attaches to their bodies. As bees and insects move to other flowers, the pollen rubs off onto other flowers. This process is called pollination and is necessary for plants to reproduce. To make themselves more attractive to potential pollinators, plants have adapted to have bright flowers. Some examples are below:

 **Lilac** Has bright flowers to attract bees	 **Spider Orchid** Has flowers that mimic female bees to attract male bees	 **Glacier Lily** Has bright flowers to attract hummingbirds

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Sex Pheromones

Plant Structure

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Spider Orchids are an interesting case because they attract pollinators by mimicking a female bee. They release an irresistible chemical scent, the female sex pheromone, to attract male bees. With the scent of a female bee covering the spider orchid, male bees land on the flower and end up pollinating them.

6th Grade Science Unit 4: A Warmer World

Task 3: Feeling The Impact

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	**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.

pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]			
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	**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	**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.	**No CCC listed**

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solutions.	constraints, including scientific knowledge that may limit possible solutions.	Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	
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

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Task 3: Feeling The Impact

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.

4. 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.

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 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.

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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.

2. 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.

3. 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.

2. 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.

3. 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.

4. 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.

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: 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?

3. 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?

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.

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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.

Research Source Options

Organism	Options of Sources
Magpie Lark	• https://www.bou.org.uk/mainwaring-climate-change-nests/
Shorebird	• https://www.birdwatchingdaily.com/news/conservation/increase-shorebird-nest-predation-climate-change/
Finnish Bird	• https://www.sciencedaily.com/releases/2018/01/180111100848.htm
Salmon	• https://blogs.ei.columbia.edu/2015/02/03/climate-change-poses-challenges-to-plants-and-animals/ • https://www.worldwildlife.org/stories/sockeye-salmon-and-climate-change
Whooping Crane	• https://phys.org/news/2017-09-climate-affecting-whooping-cranes-migration.html
Hummingbird	• https://www.audubon.org/conservation/how-climate-change-affects-hummingbirds-feeding-behavior • https://www.climatecentral.org/gallery/graphics/climate-change-risk-to-hummingbirds • https://bioone.org/journals/natural-areas-journal/volume-34/issue-2/043.034.0213/Timing-is-Everything--An-Overview-of-Phenological-Changes-to/10.3375/043.034.0213.full
Caribou	• https://www.seattletimes.com/seattle-news/environment/5-plants-and-animals-utterly-confused-by-climate-change/ • https://www.uwsp.edu/wildlife/Ungulates/Pages/Moose/Moose-Habitat.aspx
Spider Orchid	• https://www.theguardian.com/environment/2018/apr/05/climate-change-threatens-rare-british-orchid-that-tricks-bees-into-mating • https://www.theguardian.com/environment/2014/nov/06/climate-change-is-disrupting-flower-pollination-research-shows
Lilac	• https://www.thoughtco.com/spring-phenology-and-global-climate-change-1203890
Glacier Lily	• https://www.aaas.org/hummingbirds-lilies-thrown-climate-change • https://bioone.org/journals/natural-areas-journal/volume-34/issue-2/043.034.0213/Timing-is-Everything--An-Overview-of-Phenological-Changes-to/10.3375/043.034.0213.full