Stanford NGSS Integrated Curriculum
An Exploration of a Multidimensional World

UNIT 2

Extreme Living

How do people use technology to survive in regions with different climates?

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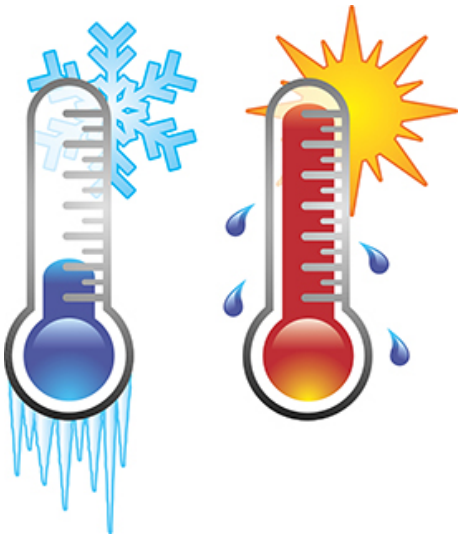
6th Grade Science Unit 2: Extreme Living
Culminating Project

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Challenge

In the Lift-Off Task, we saw pictures of places that seem impossible to live in! How are people able to live in regions with freezing temperatures or scorching heat?



Your task is to help make it possible for people to live in these places. As a group, select a region with an extremely hot or extremely cold climate. After exploring the causes of such extreme climates, your group will first design a product that makes it more comfortable for people to live in this region, and then present it in the format of your choice. Individually, you will also write a consumer report to review the science behind why your product is needed and how it works. This may also be in the format of your choice (e.g., written report, flyer, video, blog, etc.).

Group Project Criteria for Success

Your product presentation should include:

- ❑ A description of the selected region
  - What is the climate like in that region?
  - What are the causes of this climate?
  - Why does the climate make it difficult to live in this region?
- ❑ A labeled diagram or physical prototype of the product
- ❑ An explanation of how the device works, including descriptions of:
  - Temperature
  - Thermal Energy Transfer
  - Kinetic energy of particles
- ❑ Quality Presentation Structure
  - Includes visuals related to the content
  - Is organized logically
  - Is interesting to the audience

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Culminating Project

Individual Project Criteria for Success

The Consumer Report should include:

- ❑ A definition of the problem the product addresses:
  - Where is the region and why is it difficult to live there?
  - What criteria would make a successful solution to this problem?
  - What makes it difficult to solve this problem?

- ❑ A detailed description of the climate in that region, including model(s) that show:
  - Why the location of the region on Earth results in its extreme temperature
  - How atmospheric and oceanic circulation affect the climate in your region
  - The processes that create the water conditions in your region
  - *For at least one of the above bullets, cite patterns in data that allowed you to figure out these cause-and-effect relationships

- ❑ A description of the design process:
  - Describe your original design: What proportional relationships from the Task 4 investigations inspired the original design of your product?
  - What data from various tests did you use to make improvements on your final design?

- ❑ A labeled diagram of your product that explains how it works, including:
  - A description of how your product helps individuals stay warm or stay cool
  - A model that shows how your product affects energy transfer and the kinetic energy of particles

- ❑ Pros and cons of the final product

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Culminating Project

Consumer Report Peer Review Feedback

Complete after you have a full first draft of your Consumer Report.

Consumer Report Owner's Name	
Consumer Report Reviewer's Name	

Review the following sections of the Consumer Report:

- ❑ A definition of the problem the product addresses:
  - Where is the region and why is it difficult to live there?
  - What criteria would make a successful solution to this problem?
  - What makes it difficult to solve this problem?

  - ➢ Positive Comment:

  - ➢ Constructive Comment:

- ❑ A detailed description of the climate in that region, including model(s) that show:
  - Why the location of the region on Earth results in its extreme temperature
  - How atmospheric and oceanic circulation affect the climate in your region
  - The processes that create the water conditions in your region
  - *For at least one of the above bullets, cite patterns in data that allowed you to figure out these cause-and-effect relationships

  - ➢ Positive Comment:

  - ➢ Constructive Comment:

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Culminating Project

- ❑ A description of the design process:
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  - ➢ Positive Comment:

  - ➢ Constructive Comment:

- ❑ A labeled diagram of your product that explains how it works, including:
  - A description of how your product helps individuals stay warm or stay cool
  - A model that shows how your product affects energy transfer and the kinetic energy of particles

  - ➢ Positive Comment:

  - ➢ Constructive Comment:

- ❑ Pros and Cons of the final product

  - ➢ Positive Comment:

  - ➢ Constructive Comment:

6th Grade Science Unit 2: Extreme Living
3-Dimensional Individual Project Rubric

Overview: The following rubrics can be used to assess the individual project: a Consumer Report for a Thermal Product. Each rubric is aligned to one section of the *Individual Project Criteria for Success*, located on your Culminating Project Student Instructions. Use these rubrics to see if you are doing your best work on your individual project.

Rubric 1: Student defines the problem of living in a region with extreme temperatures, including criteria of success and constraints that might limit possible solutions.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **does not** define the problem of living in a region with extreme temperatures **and/or** includes **inaccurate or irrelevant** criteria of success and constraints that might limit possible solutions.	Student **accurately** defines the problem of living in a region with extreme temperatures, including **accurate** criteria of success **OR** constraints that might limit possible solutions.	Student **accurately** defines the problem of living in a region with extreme temperatures, including **accurate** criteria of success **but partial** constraints that might limit possible solutions.	Student **accurately** defines the problem of living in a region with extreme temperatures, including **accurate and complete** criteria of success and constraints that might limit possible solutions.

Rubric 2: Student develops and uses a model to describe how the unequal heating of Earth's surface leads to variations in climates around the world.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student develops and uses a model to **inaccurately** describe how the unequal heating of Earth's surface leads to variations in climates around the world. OR Student **partially** describes how the unequal heating of Earth's surface leads to variations in climates around the world but **does not use a visual model**.	Student develops and uses a model to **incompletely** describe how the unequal heating of Earth's surface leads to variations in climates around the world. OR Student **completely** describes how the unequal heating of Earth's surface leads to variations in climates around the world but **does not use a visual model**.	Student develops and uses a model to **mostly** describe how the unequal heating of Earth's surface leads to variations in climates around the world.	Student develops and uses a model to **completely** describe how the unequal heating of Earth's surface leads to variations in climates around the world.

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3-Dimensional Individual Project Rubric

Rubric 3: Student develops a model to explain how patterns of atmospheric and oceanic circulation determine their region's climate.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student develops a model to **inaccurately** explain how patterns of atmospheric and oceanic circulation determine their region's climate. OR Student **does not** develop a visual model to explain how patterns of atmospheric and oceanic circulation determine their region's climate.	Student develops a model to **incompletely** explain how patterns of atmospheric and oceanic circulation determine their region's climate. OR Student develops a model to **completely** explain how patterns of atmospheric and oceanic circulation determine climates, **but it is not specific to their region**.	Student develops a model to **mostly** explain how patterns of atmospheric and oceanic circulation determine their region's climate.	Student develops a model to **completely** explain how patterns of atmospheric and oceanic circulation determine their region's climate.

Rubric 4: Student develops a model to describe how water is cycled through Earth systems via various processes driven by energy from the Sun and the force of gravity.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student develops an **inaccurate** model to describe how water is cycled through Earth systems via various processes. OR Student **partially** describes how water is cycled through Earth systems via various processes driven by energy from the Sun and the force of gravity, **but no model is present.**	Student develops an **incomplete** model to describe how water is cycled through Earth systems via various processes. OR Student **completely** describes how water is cycled through Earth systems via various processes driven by energy from the Sun and the force of gravity, **but no model is present.**	Student develops a **partial** model to describe how water is cycled through Earth systems via various processes driven by energy from the Sun **or** the force of gravity.	Student develops a **complete** model to describe how water is cycled through Earth systems via various processes driven by energy from the Sun **and** the force of gravity.

6th Grade Science Unit 2: Extreme Living
3-Dimensional Individual Project Rubric

Rubric 5: Student cites patterns to describe a cause and effect relationship that explains regional climate conditions.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student cites **irrelevant** patterns to **inaccurately** describe a cause and effect relationship that explains regional climate conditions.	Student cites **relevant** patterns **but does not explicitly connect them to** a cause and effect relationship that explains regional climate conditions.	Student cites **relevant** patterns to **accurately** describe **one** cause and effect relationship that explains regional climate conditions.	Student cites **relevant** patterns to **accurately** describe **multiple** cause and effect relationships that explain regional climate conditions.

Rubric 6: Student describes the proportional relationships among energy transfer, the type of matter, the mass, and change in temperature, including how these relate to the kinetic energy of particles.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **inaccurately** describes the proportional relationships among energy transfer, the type of matter, the mass, **and/or** change in temperature.	Student **incompletely** describes the proportional relationships among energy transfer, the type of matter, the mass, **and/or** change in temperature.	Student **mostly** describes the proportional relationships among energy transfer, the type of matter, the mass, **and/or** change in temperature, including how these relate to the kinetic energy of particles.	Student **completely** describes the proportional relationships among energy transfer, the type of matter, the mass, **and** change in temperature, including how these relate to the kinetic energy of particles.

Rubric 7: Student redesigns a thermal product to better meet the criteria for success, referencing the relevant test data of different products to explain why they combine best characteristics.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student redesigns a thermal product to better meet the criteria for success, **but does not** explain why they combine best characteristics. OR Student redesign a thermal product that **shows no improvement from original design** OR **does not combine best characteristics from other designs** to better meet the criteria for success.	Student redesigns a thermal product to better meet the criteria for success, **but does not reference** the relevant test data of different products to explain why they combine best characteristics.	Student redesigns a thermal product to better meet the criteria for success, **referencing at least one piece** of relevant test data of different products to explain why they combine best characteristics.	Student redesigns a thermal product to better meet the criteria for success, **referencing all** of the relevant test data of different products to explain why they combine best characteristics.

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3-Dimensional Individual Project Rubric

Rubric 8: Student shows and explains how their design uses scientific principles to minimize or maximize thermal energy transfer.

Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Student **inaccurately** shows **and/or** explains how their design uses scientific principles to minimize or maximize thermal energy transfer. OR Student's design **does not** minimize or maximize thermal energy transfer.	Student **incompletely** shows **and/or** explains how their design uses scientific principles to minimize or maximize thermal energy transfer.	Student **partially** shows and explains how their design uses scientific principles to minimize or maximize thermal energy transfer.	Student **completely** shows and explains how their design uses scientific principles to minimize or maximize thermal energy transfer.

6th Grade Science Unit 2: Extreme Living

Project Organizer

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

You will be designing a product that makes it more comfortable for people to live in a region with an extreme climate. After each task, you will return to the table below to organize what you learn as you go through the unit. By the end of the five tasks, you will have all this information to use for your culminating project. For each activity, be sure to include answers to **ALL** the questions provided.

Lift-Off Task: Extreme Conditions	Research a few different regions with an extreme climate (too hot or too cold). As a group, choose one of these regions to focus on for your culminating project and describe the extreme climate there. Then individually, ❒ Define the **problem**: Why is it difficult to live in this region? ❒ Identify the **criteria** for a successful solution: How will you know your product has solved the problem? ❒ Identify the **constraints** of solving this problem: What might make it hard to solve this problem?
Task 1: Climate, Part 1 – Heating the Earth	Research the region you selected. ❒ Where is it located on Earth? ❒ How can its location on Earth explain the typical temperature in the region? ❒ Draw a Sun-Earth model to show and explain a major cause of your region's climate.

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Project Organizer

Task 2: Climate, Part 2 – Oceans and Atmosphere	For the region you selected: ❒ Construct a model to explain how atmospheric and oceanic circulation affect the climate in your region.

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Project Organizer

Task 3: A Water Molecule's Journey	Think about the region you selected. ❒ What are some ways that water is a part of your region's climate? ❒ Using words or a model, describe the processes that create the water conditions in your region.
Task 4: Thermal Energy Transfer	Think about the climate in the region you selected. ❒ Will your product need to help people stay warm or cool down? ❒ Would this require increasing the kinetic energy of the particles or decreasing the kinetic energy of the particles? Explain. ❒ Based on your explorations, how might you be able to make this possible? What factors should your product consider?

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Project Organizer

Task 5: Extreme Living Conditions	You now have a revised prototype of that product! ❒ Draw a labeled diagram of your final product. • Show how thermal energy transfer is either minimized or maximized. ❒ Explain how it works. ❒ Describe how you combined best characteristics from different designs to create a product that best meets your criteria and constraints. • Cite the data that supported your decisions.

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Lift-Off Task: Extreme Conditions

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Humans are able to survive in a wide variety of climates around the world. Some of these climates are very extreme! Can you imagine living in such extreme conditions? Make some observations as you compare the photos on the left to the photos on the right:

Part A: If you wanted to know more about humans surviving in extreme climates, what questions would you ask? Individually record any questions you would ask in order to better understand how to live in extreme climates.

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Lift-Off Task: Extreme Conditions

Part B: As a group,

- Discuss what questions each member wrote on his or her list.
- On a large piece of poster paper:
  - Write the phrase "Humans Surviving in Extreme Climates" in the middle of your poster and draw a circle around it.
  - Around the circle, record the questions that were similar across your group members.
  - Draw lines to link together questions that relate to each other.
  - Draft possible answers to the questions, using your prior knowledge. Connect these to the questions on your poster.
- Post your group poster on the wall.
- Walk around and look at each groups' ideas.

Part C: As a whole class,

- Construct a class concept map with the phenomenon in the middle: "Humans Surviving in Extreme Climates".
  - Decide which key questions you want to have on the concept map.
  - Draw lines with arrows between two key questions to show that there is a relationship.
  - Make as many connections as you can between the questions on the concept map.
- It's important for everyone to share their ideas and it's okay if you don't agree.
- You will revise and add new questions and information to this concept map as you learn more about climate conditions and heat-related technologies.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Connecting to the Culminating Project

You have been asked to design a product that makes it more comfortable for people to live in a region with an extreme climate. Research a few different regions with an extreme climate (too hot or too cold). As a group, choose one of these regions to focus on for your culminating project and describe the extreme climate there. Then individually,

- ✓ Define the **problem**: Why is it difficult to live in this region?
- ✓ Identify the **criteria** for a successful solution: How will you know your product has solved the problem?
- ✓ Identify the **constraints** of solving this problem: What might make it hard to solve this problem?

This should be completed individually in your Project Organizer.

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Lift-Off Task: Extreme Conditions

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Reflection

Individually reflect on the Lift-Off Task, using the questions provided:

1. At the beginning of this task, you made a list of questions you have about humans surviving in extreme climates. 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?

2. In this unit, we will be focusing on three crosscutting concepts:
   - **Scale, Proportion, and Quantity**: Proportional relationships among different quantities tell us about the magnitude of processes.
   - **Systems and System Models**: Models can be used to represent systems and their interactions.
   - **Energy and Matter**: The transfer of energy drives the motion or cycling of matter, and it can be tracked as it flows through a system.

   Looking at your class concept map, give one example of how a crosscutting concept came up in today's task.

3. 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?

6th Grade Science Unit 2: Extreme Living
Task 1: Climate, Part 1 - Heating the Planet

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

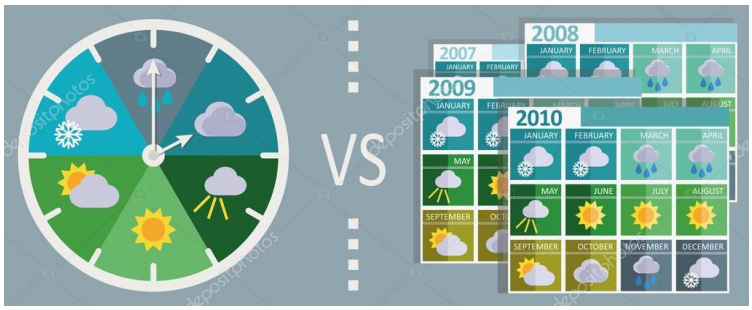
Engage

In the Lift-Off task, you saw examples of people living in extreme climates. What causes these environments to have such extreme climates? What made some regions so hot and others so cold? In this task, we will investigate one of the major reasons behind a region's climate.

What do you already know about weather and climate?

1. In pairs, discuss what you think the difference is between weather and climate.

2. Your teacher will read each of the statements below. Move to either the weather or climate corner of the room depending on whether you think the statement is describing weather or climate. Be prepared to give a reason for why you are in that corner!



   a. It rained on May 8.
   b. Germany is a cold country.
   c. Summer is hot.
   d. The news says it is supposed to rain this weekend.
   e. Florida is hotter than Alaska.
   f. That was an amazing lightning storm last night.
   g. Cities near the ocean tend to be wet.
   h. It might snow in Tahoe tomorrow.
   i. Today it was colder than usual.
   j. 1992 was one of the coldest summers on record.
   k. There is a hurricane predicted to hit tomorrow.
   l. The highest recorded temperature of all time was 136 degrees Fahrenheit in Libya.
   m. It rains every October.

3. As a class, define the difference between weather and climate and record below:

6th Grade Science Unit 2: Extreme Living
Task 1: Climate, Part 1 - Heating the Planet

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

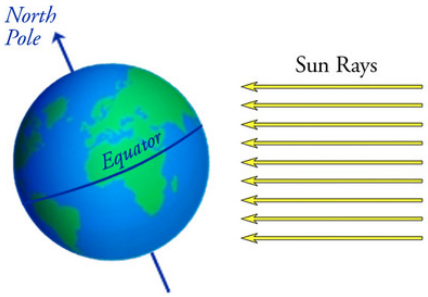
Explore

Now that you have an understanding of what we mean when we say "climate", let's explore one major reason why climates around the world can be so different.

Systems and System Models: You already know that the Sun warms the Earth. But does every part of Earth get the same amount of energy from the Sun all the time? To figure out the answer to this question, your group will need to use models to visualize the relationship between the Sun and the Earth.

Physical Model:

1. Use the following materials to make a model that represents the Earth and the Sun.
    - Sun: Flashlight or Other Light Source
    - Earth: Styrofoam Ball
    - Poles: Toothpicks
    - Equator: Rubber Band



2. Model the process of Earth doing one full rotation over the course of one day by following the instructions below:
    a. Hold your Sun flashlight so it shines on Earth's Equator. Remember that the Sun never moves, so don't move your Sun during the modeling process!
    b. Holding onto the South Pole, tilt Earth slightly, as shown in the picture above (23°).
    c. Slowly rotate, or spin, Earth on its axis, keeping it at the same tilt during one entire rotation. Observe carefully what happens to the light that reaches Earth.
    d. Now place Earth on the opposite side of the Sun and repeat. Observe.

3. Discuss and answer the discussion questions below, repeating the modeling process as necessary:

Discussion Questions	Your Responses
In general, what locations on Earth get more sunlight and what locations get less?	
How do you think the different amounts of sunlight affect temperature in these areas?	
Why do you think the amount of sunlight that hits Earth varies by region?	

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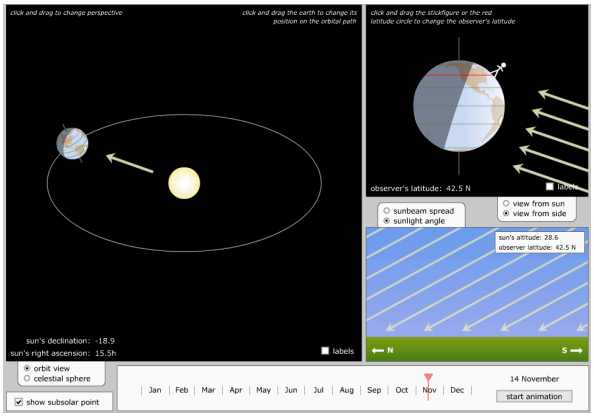
Task 1: Climate, Part 1 - Heating the Planet

Computer Model:

1. Put the following url in your computer browser: https://astro.unl.edu/naap/motion1/animations/seasons_ecliptic.html.

2. Play around with the simulation to get comfortable with the functions:
   a. To change the time of year: You can move the Earth around its orbit in the left-hand image OR you can set the month on the bottom timeline.
   b. To change the location of the region being observed: You can move the stick figure in the top right image.
   c. To observe the amount of sunlight hitting that region on Earth: analyze the image on the bottom right. The more the arrows are tilted, the less directly sunlight is hitting that region.



3. Try out the following settings and discuss the questions to help you analyze the model:

Time of Year	Location	Observations of the Sun's Rays	How do you think this affects the temperature in the region at this time of year?
November	Northern Hemisphere		
June	Northern Hemisphere		
June	Southern Hemisphere		
November	Southern Hemisphere		
November	Equator		
June	Equator		

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Task 1: Climate, Part 1 - Heating the Planet

4. Pick a location and run the simulation, using the "Start Animation" button in the bottom right corner.
    a. Make any final observations as the Earth moves through its orbit over the course of one year.

5. Discuss the **Patterns** you observed:
    a. What part of the world gets the most direct sunlight throughout the year? Why?

        i. The least amount of direct sunlight? Why?

    b. How does the amount of sunlight hitting Earth vary throughout the year in a region?

        i. Why do you think this happens?

        ii. How do you think this affects the climate of that region during different times of year?

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Task 1: Climate, Part 1 - Heating the Planet

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explain

Developing and Using Models: Your friend wants to plan a ski trip to New Zealand during their winter break in December. Individually, explain to your friend whether this is a good idea and draw a model to illustrate your explanation.

Written Explanation	Model

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Elaborate

Explaining the relationship between the Sun, Earth, and climate is very complex! Just like in Unit 1, let's use the *Stronger/Clearer* method to improve your explanation and model.

1. **Individual Think Time:** Take a minute to think about how you will describe your explanation and model to a first partner. When you are ready, fold your paper so only the model is visible.

2. **Partner Discussions 1:** You will work in pairs with another student. One of you will be Student A and the other Student B. Student A will start:
    - **Student A:** Without reading what you wrote, describe and support the thinking you used in your explanation. You may refer to your model to help show what you are describing.
    - **Student B:** Listen and ask clarifying questions. Ask questions to help Student A add detail to their explanation. For example, you might ask, "How can you show that in your model?" or "In which *Explore* model did you learn that?" or "What do you think the tilt of the Earth has to do with it?"

- **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 explanation and model. Write down new notes, insights, and questions.

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

5. **Final Explanation:** After you have worked with partners to clarify your thinking, review your notes. Revise your explanation and model in the *Explain*.

6th Grade Science Unit 2: Extreme Living

Task 1: Climate, Part 1 - Heating the Planet

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Evaluate: Connecting to the Culminating Project

You have been asked to design a product that makes it more comfortable for people to live in a region with an extreme climate. Research the region you selected.

- ✓ Where is it located on Earth?
- ✓ How can its location on Earth explain the typical temperature in the region?
- ✓ Draw a Sun-Earth model to show and explain a major cause of your region's climate.

This should be individually in your Project Organizer.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Reflection

Individually reflect on Task 1, using the questions provided:

1. At the beginning of this task, you were given a list of statements to identify as relating to weather or climate. Would the modeling you did in the rest of this task relate to weather or climate? Why?

2. In this task, we focused on the crosscutting concept of:
   - **Systems and System Models**: Models can be used to represent systems and their interactions.

   Where do you see examples of **System and System Models** in this task?

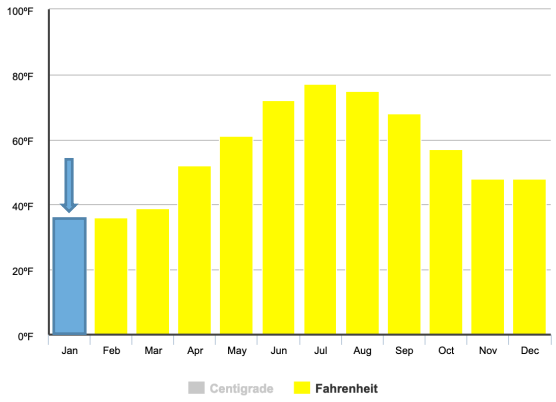
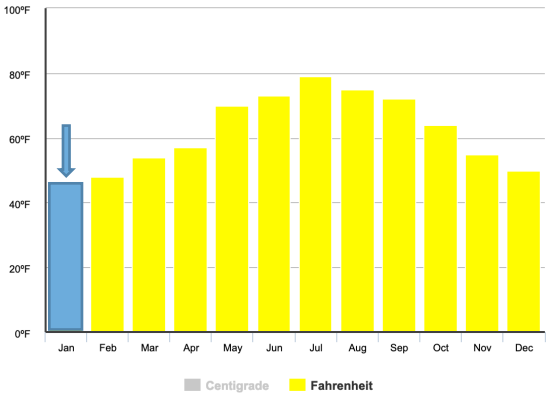
3. Now that you have learned more about a major cause of climates, what questions do you still have?

6th Grade Science Unit 2: Extreme Living
Task 2: Climate, Part 2 – Oceans & Atmosphere

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Engage

In the last task, you figured out that regions near the equator are warm, and that it gets cooler as you move away from the equator. We might then expect that regions that are the same distance from the equator, or at similar latitudes, should have similar climates and experience similar temperatures. Look at the data below: does this pattern always hold true?

City	**New York City, USA**	**Rome, Italy**
Latitude	**41°N**	**42°N**
Average Monthly Temperature (°F)		

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Individually:

Using what you know from Task 1, and the information above, explain how the temperatures in January could be so different for two cities at nearly identical latitudes. Write your explanation on an index card.

In Groups:

1. Share - Each person reads their index card, and places it on the table for all to see.
2. Discuss - Talk about which ideas seem to fit best with what you know, and what the data tells you.
3. Consensus - Write a group explanation on poster paper.
4. Display - Be prepared to share your explanation with the class in a gallery walk.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

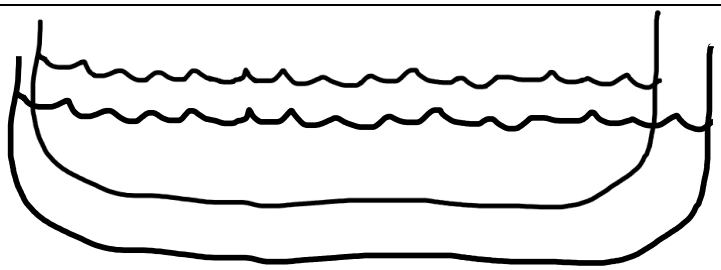
Explore

Systems and System Models: Now that you have come up with some ideas for why New York City and Rome could have such different winter temperatures, let's explore two models that may help us figure out why this happens.

Ocean Circulation Model:

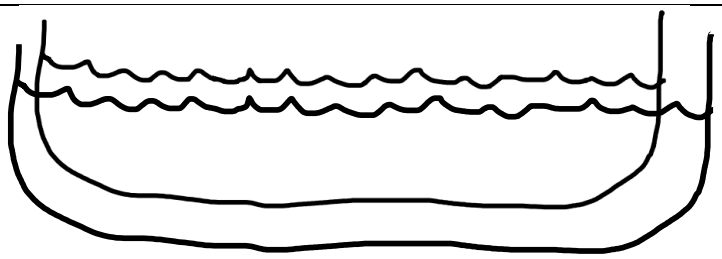
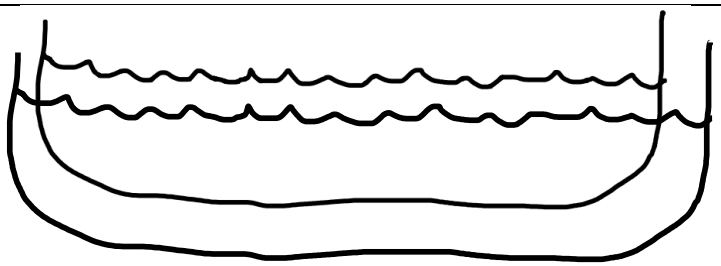
Your teacher will show you a video or demonstration involving the mixing of cold water, room temperature water, and hot water. Food coloring has been added to the cold water (blue) and hot water (red) in order for you see more clearly how what happens when all three temperatures mix together.

1. Using the blank diagrams below, individually record your observations from the video/demonstration.

	Observations
What happens when the ice cube is first placed in the water tub?	

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

What happens when the hot water is first placed in the water tub?	
What happens after you wait a while?	

2. With your group,
    a. Discuss what you noticed.
    b. Predict what you think may happen to the hot (red) water and cold (blue) water after one hour has passed? Explain your prediction.

3. Individually, write and/or draw your prediction and explanation below:

Prediction	Explanation

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Questions – What are you still wondering about? What are you unsure of?

Atmospheric Circulation Model:

Your teacher will show you another demonstration, this one involves a helium-filled balloon, and a heat source.

1. Use the space below to individually record your observations. Be sure to include drawings when helpful.

Before Heating	After Heating

2. Use the space below to individually explain what you think is happening during this demonstration. Be sure to include drawings when helpful.

Explanation

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Questions – What are you still wondering about? What are you unsure of?

Comparing Models

1. With your group**,** compare and discuss your explanations from the Oceanic Circulation Model and the Atmospheric Circulation Model.
    a. What did everyone's oceanic models have in common? How were they different?
    b. What did everyone's atmospheric models have in common? How were they different?

2. In the table below, **individually** describe at least two similarities and two differences between your two explanations.

Similarities	
Differences	

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explain

Understanding why Rome and New York City have such different average winter temperatures involves both the movement of water in the oceans and air in the atmosphere. In the Explore demonstrations, you made some observations about how water and air move in response to differences in temperature. In this activity, you're going to use everything you've learned to start creating oceanic and atmospheric circulation.

Initial Ideas:

1. In groups, discuss the questions in the chart below.
2. After discussing the questions, write/draw your responses in the chart below.

How do you think the movement of **water** in the ocean contributes to the temperature difference between Rome and New York City in January?	How do you think the movement of **air** in the atmosphere contributes to the temperature difference between Rome and New York City in January?

3. Individually, read and annotate the reading provided by your teacher: *How Do Air and Water Move Around Our Planet?*

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Systems and System Models: Understanding how ocean currents and atmospheric circulation contribute to Rome's higher average winter temperatures can seem complicated. One way to help understand a complex phenomenon or system is to create a model. To make a model, first think of all of the smaller parts (*components*) of the phenomenon or system, and then explain how the parts affect each other (*interactions*).

1. **Components** – In the table below, individually list all the parts of the oceanic and atmospheric systems. Refer back to the reading, as needed. In the last column, make a drawing to represent each part.

	Components (parts)	Representation (drawing)
Oceanic Circulation System		

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Task 2: Climate, Part 2 – Oceans & Atmosphere

	Components (parts)	Representation (drawing)
Atmospheric Circulation System		

Gallery Walk – After completing the table above, you will have 5 minutes to walk around the room to see how other people represent each component. As you walk, look to see:

a. If there are any missing components you forgot to consider.
b. How others choose to represent each component.
c. If you like someone else's idea, use it in your table above, and credit the person you borrowed from by putting their name next to the representation in your table.

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

2. **Interactions** – With a partner, describe with words **AND** drawings how each part you listed affects the other parts. Be sure to include the relevant parts from both of your lists of components.

Oceanic Circulation Interactions
Atmospheric Circulation Interactions

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Elaborate

Developing and Using Models: Now we can combine all the components and interactions together in order to describe how oceanic and atmospheric circulation influence climate. This will help your group create one model to explain how Rome could have higher average January temperatures than New York City.

Criteria for Model:

1. Your model should use words, arrows, and drawings.
2. Your model may be done with or without technology.
3. Your model must include at least the following components (terms):
    a. latitude
    b. temperature
    c. atmosphere
    d. wind
    e. ocean current
    f. density
    g. heat

Be prepared to share your model with the class.

6th Grade Science Unit 2: Extreme Living

Task 2: Climate, Part 2 – Oceans & Atmosphere

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Evaluate: Connecting to the Culminating Project

You have been asked to design a product that makes it more comfortable for people to live in a region with an extreme climate. For the region you selected:

- ✓ Construct a model to explain how atmospheric and oceanic circulation affect the climate in your region.

This should be done individually in your Project Organizer.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Reflection

Individually reflect on Task 2, using the questions provided:

1. At the beginning of this task, you were introduced to a phenomenon (New York City/Rome) that did not seem to follow expected climate patterns. By using models in this task, do you now feel confident that you can explain the phenomenon to your parents? Why or why not?

2. In this task, we focused on the crosscutting concept of:
   - **Systems and System Models**: Models can be used to represent systems and their interactions.

   Where do you see examples of **System and System Models** in this task?

3. Now that you have learned more about how oceanic and atmospheric circulation affect local climates, what questions do you still have?

6th Grade Science Unit 2: Extreme Living
Task 3: A Water Molecule's Journey

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Engage

In Tasks 1 and 2, you explored the causes of different climates around the world. In this task, we will dig into one specific aspect of climate—water.

Think back to how you defined climate at the beginning of Task 1 and picture different regions around the world. In pairs, discuss: what are some ways that water is a part of different climates? Where do we see water in different environments? Make a list below.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explore

In this task, we are going to focus on how water moves through Earth's systems and how this impacts the climates of people in different regions. To do this, you are going to take the journey of a water molecule! Follow the instructions below to start your journey:

1. Your teacher will tell you which station to start from. Write this as your location/description next to #1 in your chart below.
2. At each station, read about your location and roll the dice to see where you will go next. Fill in your chart each time to keep track of your journey as a water molecule.
3. Continue until you have recorded 10 locations (Keep in mind that sometimes you repeat a station you've visited before!)

6th Grade Science Unit 2: Extreme Living

Task 3: A Water Molecule's Journey

	Location and Description	Describe How You Travel To Your Next Location
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

6th Grade Science Unit 2: Extreme Living

Task 3: A Water Molecule's Journey

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explain

Developing and Using Models: While everyone's journey as a water molecule was a little bit different, you may start to notice some things in common. First, compare your journey with your other group members. Then, as a group, combine all your journeys to make a poster map that shows the cycling of water through Earth's systems. Use pictures, words, and arrows and make sure to include the following:

- The different states water exists in on Earth
- Places where you can find water
- The processes that cycle water
- **Energy and Matter**: The energy and forces that drive these different processes

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Elaborate

Energy and Matter: Imagine that your younger sibling is explaining to you what happens to puddles that dry on the sidewalk. Now that you have investigated the water cycle, critique their explanation using the *Critique, Correct, and Clarify* technique below.

Prompt: What happens to the water when a puddle dries on the sidewalk?

In pairs:

1. Critique: Analyze the explanation below. Identify any errors, unclear ideas, or missing details. Share your ideas with a partner.

   > *When a puddle dries on the sidewalk, the water disappears completely. This is because the air after a storm creates an energy that makes the water disappear. Water will only be created again by the sky during the next storm.*

2. Correct: Individually write an improved explanation below.

3. Clarify: With a partner, discuss and describe how and why you corrected the explanation.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Evaluate: Connecting to the Culminating Project

You have been asked to design a product that makes it more comfortable for people to live in a region with an extreme climate. Think about the region you selected.

- ✓ What are some ways that water is a part of your region's climate?
- ✓ Using words or a model, describe the processes that create the water conditions in your region.

This should be done individually in your Project Organizer.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Reflection

Individually reflect on Task 3, using the questions provided:

1. At the beginning of this task, you were asked to brainstorm ways that water is a part of different climates and places that you can find water in environments. Look back at your initial list: after everything you have learned in this task, what could you add to this list? Record below.

6th Grade Science Unit 2: Extreme Living

Task 3: A Water Molecule's Journey

2. In this task, we focused on the crosscutting concept of:
    - **Energy and Matter**: The transfer of energy drives the motion or cycling of matter, and it can be tracked as it flows through a system.

   Where do you see examples of **Energy and Matter** in this task?

3. Now that you have learned more about a major part of different climates—water—what questions do you still have?

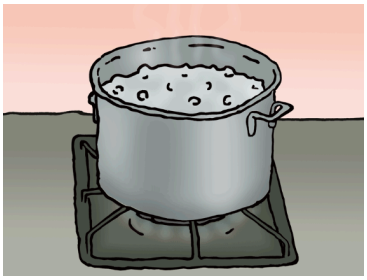
6th Grade Science Unit 2: Extreme Living
Task 4: Thermal Energy Transfer

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Engage

So far in the unit, you have been thinking about why the regions you chose have such extreme climate conditions. Your job for the culminating project is to design a product that makes it possible to live in one of these regions, even with such extreme temperatures. Before we design this product, we first need to understand how temperature actually works!

Let's start with an example that some of you may be familiar with: You are boiling a pot of water while cooking pasta. You place a cool metal spoon into the pot to stir the mixture. You have to leave the stove for a minute and when you come back, you grab the metal spoon…ouch! It's now super hot!



With a partner, make a hypothesis: Why is the handle of the spoon hot even though the handle is not submerged in the boiling water?

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explore

We know based on experiences like the one above that the temperature of objects can change. But how is temperature able to change? And what factors affect changes in an object's temperature?

Planning and Carrying Out Investigations: As a group, plan and conduct an experiment to try to answer these questions. You will choose from the materials provided by your teacher to see how the following are related to each other:

- the type of matter
- the mass of a substance
- the change in temperature of a substance

6th Grade Science Unit 2: Extreme Living

Task 4: Thermal Energy Transfer

Use the following planning questions to help you:

Experimental Design

1. Write your experimental question: Based on the materials available, what would you like to test? Why?

2. Identify the Dependent Variable: What are you trying to measure or observe at the end of the experiment?

3. Identify the Independent Variable: What will you need to manipulate (change) in order to measure this?

4. Identify the Controlled Variables: What should you keep the same so that you only measure what you want to? Or, how can you make sure you're setting up a fair test each time?

Materials

-
-
-
-
-
-
-
-
-
-

Experimental Set-Up Diagram

6th Grade Science Unit 2: Extreme Living

Task 4: Thermal Energy Transfer

Procedure

1.

2.

3.

4.

5.

6.

7.

8.

Data Collection: Conduct experiment and record data in a table below:

Prepare to share your findings!

6th Grade Science Unit 2: Extreme Living

Task 4: Thermal Energy Transfer

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explain

You now have the data to draw conclusions about different relationships you observed. It may be helpful to also use the terms that scientists use to talk about these concepts, especially if we want to compare findings with others. So, before you explain what you found through your investigation, let's get clear on these terms!

1. Read and annotate the article below:

Temperature vs. Thermal Energy vs. Heat

Temperature, thermal energy, and heat are so closely related, it can get a bit confusing. Even though we sometimes use them interchangeably, these terms actually have some important differences.

Remember in the last unit when we learned about kinetic energy—the energy of motion? Kinetic energy not only applies to the motion you can see with your eye, but also to any motion too small to be seen. We know from past science classes that all things are made up of very small particles or molecules we can't see. Even in solids, these particles are vibrating in place and so are moving ever so slightly. The more quickly the particles move, the more energy they have. Both thermal energy and temperature measure the kinetic energy of an object's particles, but the difference between them is summarized below:

- Thermal energy is the *total* kinetic energy of particles within a material or system.
- Temperature is the *average* kinetic energy of particles within a material or system.

The words *total* and *average* are very important in these definitions. For example, a swimming pool at 40 degrees (lower temperature) actually has more thermal energy than a cup of tea at 90 degrees (higher temperature)…this is because the pool contains a lot more water.

Unlike thermal energy and temperature, heat is not a property describing a material system. Heat is a measure of change because it describes the movement, or transfer, of thermal energy between objects.

2. Discuss with a partner: Turn over your paper and try to describe the difference between temperature, thermal energy, and heat in your own words.

3. **Scale, Proportion, and Quantity:** As a group, draw conclusions about your investigation.

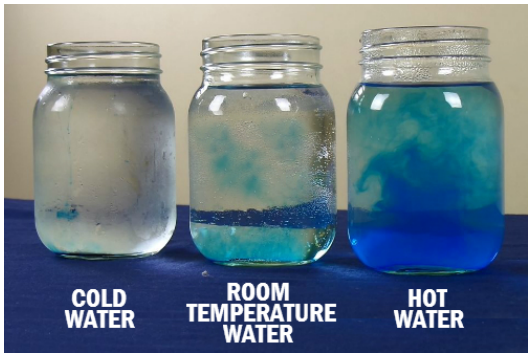
    a. What factors affect changes in an object's temperature? Use evidence from your experiment and others' experiments, as well as the article above.

    b. How and why does temperature change? Use evidence from your experiment and others' experiments, as well as the article above.

Elaborate

So far in this task, you have seen how thermal energy is transferred between objects and how this causes changes in temperature. But what is actually happening at the particle level? Why does thermal energy transfer between objects and why does the temperature change?

1. Watch your teacher mix food coloring in water at different temperatures. Individually, hypothesize: Why do you think this is happening?



6th Grade Science Unit 2: Extreme Living

Task 4: Thermal Energy Transfer

2. Now watch the rest of the video we started during the Engage. With a partner, discuss what you learned: What does this tell you about why thermal energy transfers between objects and why temperature of objects can change?

3. Now that you have seen the *Conduction* video, return to the food coloring demonstration. Individually, describe why the food coloring mixed differently at different temperatures.

    a. How do these ideas help explain what you saw in your investigations?

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Evaluate: Connecting to the Culminating Project

You have been asked to design a product that makes it more comfortable for people to live in a region with an extreme climate. Think about the climate in the region you selected.

- ✓ Will your product need to help people stay warm or cool down?
- ✓ Would this require increasing the kinetic energy of the particles or decreasing the kinetic energy of the particles? Explain.
- ✓ Based on your explorations, how might you be able to make this possible? What factors should your product consider?

This should be individually in your Project Organizer.

6th Grade Science Unit 2: Extreme Living

Task 4: Thermal Energy Transfer

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Reflection

Individually reflect on Task 4, using the questions provided:

1. At the beginning of this task, you were asked make a hypothesis to the following question: Why is the handle of the spoon hot even though the handle is not submerged in the boiling water? Look back at your hypothesis. After everything you have learned through this task, what would you change or add to your response? Record this below:

2. In this task, we focused on the crosscutting concept of:
    - **Scale, Proportion, and Quantity**: Proportional relationships among different quantities tell us about the magnitude of processes.

   Where do you see examples of **Scale, Proportion, and Quantity** in this task?

3. Now that you have learned more about temperature for the design of your product, what questions do you still have?

6th Grade Science Unit 2: Extreme Living
Task 5: Extreme Living Solutions

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Engage

Your job for your culminating project is to design a product to make it possible to live in a region with extreme temperatures. In the last task, you investigated what temperature is and different factors that affect temperature change. Today, you'll be able to use what you learned in your investigations to actually design, build, and test your product!

First, individually picture the region you selected for your culminating project and use the following questions to begin brainstorming:

- What kinds of products might make the temperature conditions more comfortable for the people living there?
- Which of these products uses the science concepts you investigated in Task 4?

You will be creating a design board!

1. You will be given a stack of post-its. On each post-it, individually record an idea for a product. Don't be afraid to think outside the box…any idea is a good idea!
    - Draw a star next to ideas that use concepts about temperature and thermal energy transfer from Task 4.
    - Place your post-its on your group's poster.

2. As a group, review everyone's ideas and cluster the post-its into groups of ideas that are similar.
    - Revise and combine ideas, as necessary.

3. Decide on the best idea to design a prototype of your product.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explore

Designing Solutions: Now that you have an idea for a potential product to minimize or maximize thermal energy transfer, you can design, build, and test it to create the best possible final product. As a group, use the questions below to guide you through this design process:

6th Grade Science Unit 2: Extreme Living

Task 5: Extreme Living Solutions

1. **Define the Problem:** Before you begin designing your product, you will need to be clear on the criteria and constraints of the problem. Return to the Lift-Off section of your Project Organizer for ideas.
    a. **Criteria**: What does your product need to do? How will you measure its success?

    b. **Constraints**: What might make it hard to solve the problem?

2. **Gather Inspiration**:
    a. What evidence from the Task 4 investigations can you use to inform the design of your product?

    b. What outside research can you gather to design an even better product?

3. **Design Your Product Prototype**: Using the list of materials provided by your teacher, draw a design for your product. Consider structure, material, size, mechanism, etc. **Energy and Matter**: Include labels to show how the product will work. You will build and test it in the next part of this task.

6th Grade Science Unit 2: Extreme Living

Task 5: Extreme Living Solutions

4. **Build and Test Your Product Prototypes**
    a. Draw the setup below for an experiment to test the success of your prototype. Include labels that show all the materials used.

    b. Describe how you will run your experiment. Be sure to describe what data you will collect, and how you will collect it.

    c. Build and test your prototype. Record your data below:

6th Grade Science Unit 2: Extreme Living

Task 5: Extreme Living Solutions

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Explain

You now have data as evidence for how well your design works! But why did you get this data? As a group, make a poster to share with the class that shows:

- How your product works
- The data from your test of the prototype
- **Energy and Matter:** An explanation of why you got these results, using knowledge of thermal energy transfer and the kinetic energy of particles. (Re-read the article and re-watch the video and simulation from Task 4 if you need help!)

Other groups tested products that used different materials, structures, features, mechanisms, etc. You can learn from others' data to make your own product even better! As other groups share, individually record features about designs that might also work for your product in the space below. Include the data to support them as you will use this data for your culminating project.

Elaborate

Analyzing and Interpreting Data: Your group can use what you learned from your data and other groups' data to combine the best characteristics of designs you've seen and create the best possible product!

1. Amongst all the class designs, which products worked best to meet the criteria of your particular problem?

a. How do you know? Cite relevant data and/or observations from your test and other groups' tests.

2. What adjustments can you make (types of materials, mechanism of the produce, structure of the product, etc.) so your product best meets the criteria and constraints of your problem? Draw a labeled diagram of your revised product below. If you don't think any revisions to your product are necessary, justify why your specific design features performed better than all other designs.

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Evaluate: Connecting to the Culminating Project

You have been asked to design a product that makes it more comfortable for people to live in a region with an extreme climate. You now have a revised prototype of that product!

- ✓ Draw a labeled diagram of your final product.
  - Show how thermal energy transfer is either minimized or maximized.
- ✓ Explain how it works.
- ✓ Describe how you combined best characteristics from different designs to create a product that best meets your criteria and constraints.
  - Cite the data that supported your decisions.

This should be individually done in your Project Organizer.

6th Grade Science Unit 2: Extreme Living

Task 5: Extreme Living Solutions

Unit Essential Question: *How do people use technology to survive in regions with different climates?*

Reflection

Individually reflect on Task 5, using the questions provided:

1. At the beginning of this task, you brainstormed a variety of different ideas. After seeing all the tests of the different prototypes, are there any other ideas from your poster that you would still want to try?

2. In this task, we focused on the crosscutting concept of:
   - **Energy and Matter**: The transfer of energy drives the motion or cycling of matter, and it can be tracked as it flows through a system.

   Where do you see examples of **Energy and Matter** in this task?

3. Now that you have tested a design for your product, what questions do you still have?