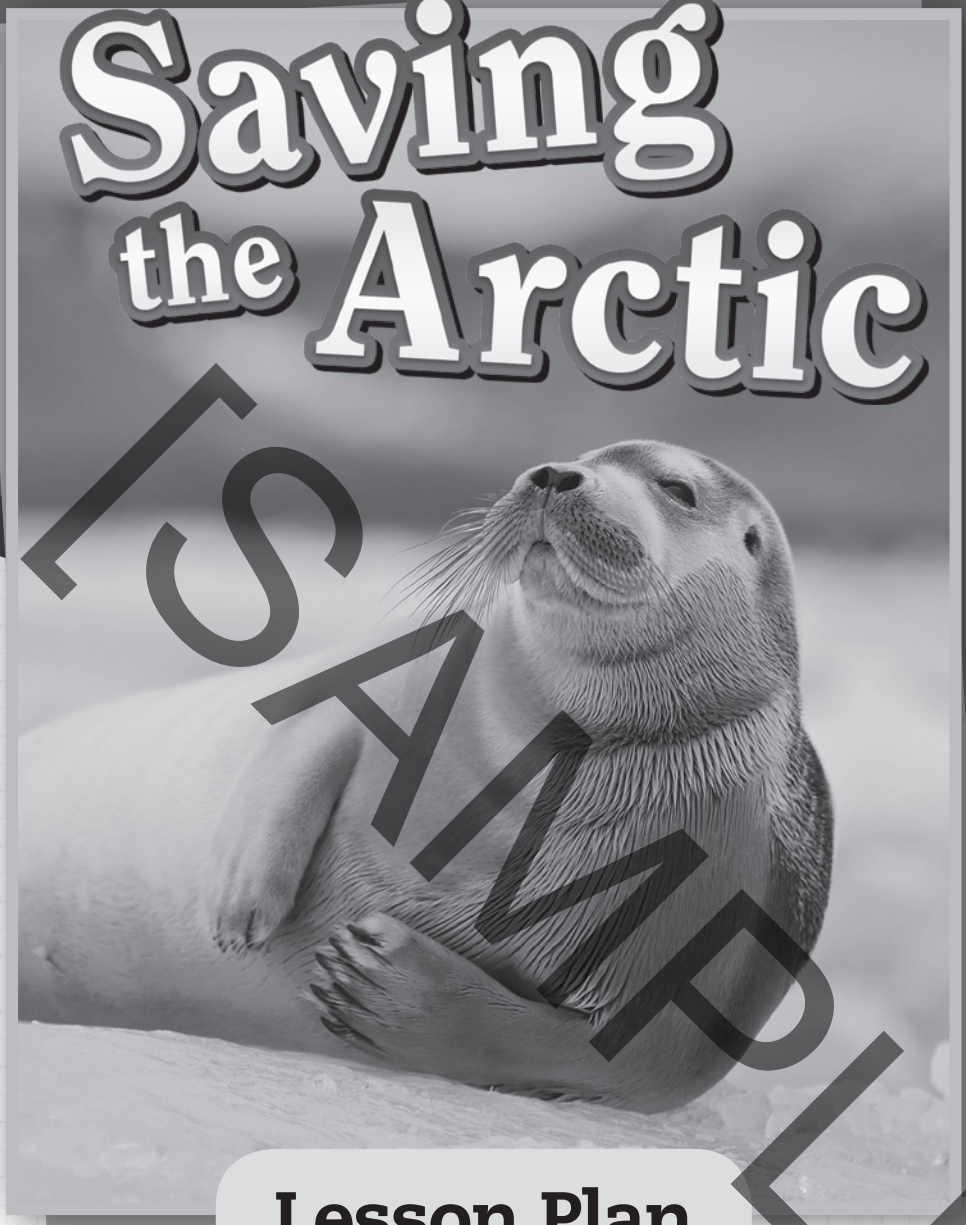
Saving the Arctic



Unit 1
Animals & Ecosystems

Lesson Plan

Author
Allison Duarte

Smithsonian STEAM Readers
Science ■ Technology ■ Engineering ■ Arts ■ Mathematics

Teacher Created Materials PUBLISHING
5301 Oceanus Drive
Huntington Beach, CA 92649-1030
www.tcmpub.com
TCM 29016 (i21033)
ISBN 978-1-4938-6801-8

Smithsonian

ISBN-13: 978-1-4938-6801-8
90000
9 781493 868018

Series Consultant

Sally Creel, Ed.D.

STEM & Innovation Supervisor/
Professional Development Consultant

Grade Level Consultants

Dr. Tamieka M. Grizzle

K–5 STEM Lab Instructor

Harmony Leland Elementary School

Stephanie Anastasopoulos, M.Ed.

TOSA, STREAM Integration

Solana Beach School District

Publishing Credits

Rachelle Cracchiolo, M.S.Ed., *Publisher*
Conni Medina, M.A.Ed., *Editor-in-Chief*
Diana Kenney, M.A.Ed., NBCT, *Content Director*
Melissa Laughlin, *Editor*
Véronique Bos, *Creative Director*
Robin Erickson, *Art Director*
Mindy Duits, *Senior Graphic Designer*
James Anderson, M.S.Ed., *Educational Technology Director*
Marissa Dunham, M.A., *Assistant Editor*
Kara Liu, *Educational Technology Specialist*
Ericka Paz, *Educational Technology Specialist*

Carol O'Donnell, *Director, Smithsonian Science Education Center*
Carol LeBlanc, *Senior Vice President of Consumer and Education Products*
Brigid Ferraro, *Vice President of Consumer and Education Products*
Smithsonian Science Education Center

Image credits

all images (except cover) from iStock and/or Shutterstock.

References to digital components are included for educators who purchased the full kit: *Smithsonian STEAM Readers: Grade 4*. Please disregard digital component references if this lesson was purchased in a different product configuration.

Answer Key: *Saving the Arctic*

page 10—Using Clues to Infer

Responses may vary. Example:

Text Clue: As the ice melts, both seals and polar bears have to change their ways; **What I Know:** Animals require food, water, and space to live and reproduce; **What I Infer:** Unless seals and polar bears adapt to a changing environment, they may not survive.

Text Clue: But what they have seen over the past few years has worried them; **What I Know:** People worry when something happens that is unexpected**; What I Infer:** The weather in the Arctic is changing in ways that is not typical.

Text Clue: Scientists all over the world study the Arctic; **What I Know:** Scientists study things they think are important; **What I Infer:** Finding ways to save the Arctic is a top priority for scientists.

page 11—Eyewitness to Change

Responses may vary. Example:

- I have not seen any caribou yet. They are usually here this time of year, and we hunt them for food.
- I saw an area where there was a recent landslide. Luckily, nobody was hurt.
- The waves were really big today, and it looks like the area near the coast has gotten smaller.

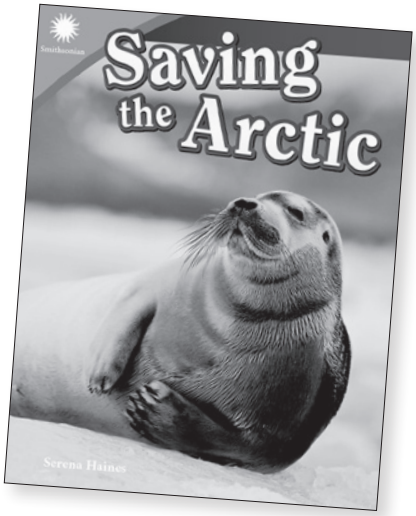
Conclusion: I hope that scientists can figure out how to keep my family and community safe.

page 17—*Saving the Arctic* Quiz

1. C
2. A
3. D
4. B
5. Responses may vary. Example: Scientists are finding ways to reduce the use of fossil fuels. They are using technology to make clean energy sources such as solar panels and wind turbines even better and available for more people around the world.

Saving the Arctic

Materials



- *Saving the Arctic* books
- copies of student activity sheets (pages 9–19)
- **STEAM Challenge materials include but are not limited to the following:**
  - ✓ cardboard pieces
  - ✓ clay
  - ✓ craft sticks
  - ✓ foil
  - ✓ glue
  - ✓ heat lamps
  - ✓ masking tape
  - ✓ medium-sized cake pans (1 per team)
  - ✓ scales
  - ✓ soil
  - ✓ straws
  - ✓ toothpicks
  - ✓ water

Learning Objectives

- **Reading:** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- **Writing:** Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
- **Speaking and Listening:** Engage effectively in a range of collaborative discussions with diverse partners on grade-appropriate topics and texts, building on and expressing ideas clearly.
- **Engineering:** Define an engineering problem, design and evaluate solutions, and optimize a design based on test results.

Phenomena

Average global temperatures are increasing. Ice in the Arctic is melting.

Lesson Timeline

Day 1	Day 2	Day 3	Day 4	Day 5–10
Introductory and **Before Reading Activities** (page 4)	**During Reading Activities** (page 5)		**After Reading Activities** (page 5)	**STEAM Challenge** and **Assessments** (pages 6–8)
Define the STEAM Challenge, and practice making an inference based on an image and caption.	Research climate change in the Arctic, use text clues and prior knowledge to make inferences, and brainstorm design solutions.		Write a journal entry about life and changes happening in the Arctic.	Design, build, test, improve, reflect on, and share a model house that can withstand melting permafrost. Complete the assessments.

Saving the Arctic (cont.)

STEAM Vocabulary

adapt climate eyewitness
Inuit permafrost

Introductory Activity

Define the Problem

1. Explain to students that the Arctic is a region at the North Pole with large sheets of ice that cover the ocean. Tell them that Earth's climate is warming and scientists are concerned about melting ice in the Arctic.
2. Sort students into pairs. Ask them to make one prediction about how melting ice impacts Arctic animals and another prediction about how people are affected by this change. Encourage students to consider how melting ice leads to a rise in sea level. Invite students to share their ideas and predictions with the class.
3. Distribute the *Saving the Arctic* books to students. Reveal the STEAM Challenge by reading pages 28 and 29 of the book. As you read, explain each step of the engineering design process.
   - Display the Interactiv-eBook for a more digitally enhanced introduction to the challenge.
4. Distribute *Make a Plan* (page 9) to students. Have them summarize the challenge. Summaries should include constraints and criteria. Provide the following sentence frame to help students summarize: *Make a _____ that can_____.*

   Note: You may wish to distribute all student activity sheets as one packet. They will be used throughout the STEAM Challenge.

Before Reading

1. Write sentences on the board that provide context clues for the vocabulary words. Have students use context clues to determine the meanings of the words. Ask students to state what they think the words mean and why. Use the sentences below or create your own:
   - Some animals will *adapt* to a changing environment by changing their diets.
   - Scientists study *climate* data to tell that average global temperatures are increasing.
   - Unlike the *eyewitness*, the officer did not see what happened.
   - The *Inuit* boy spent his whole life in the Arctic, just like his ancestors did.
   - As the *permafrost* melts, the ground becomes soft and mushy.
2. Tell students that inferences are conclusions or deeper understandings that readers make based on facts. Explain that readers can make inferences by combining clues from the text with prior knowledge.
3. Display pages 16 and 17 of the *Saving the Arctic* book and read the captions. Ask students to make inferences about the Inuit people (e.g., The Inuit people are skilled hunters.) Invite students to share text clues and prior knowledge that led to their inferences.
   - Have **below-level learners** practice making inferences based on everyday observations, such as: *The students put on their jackets and gloves before recess.*

Saving the Arctic (cont.)

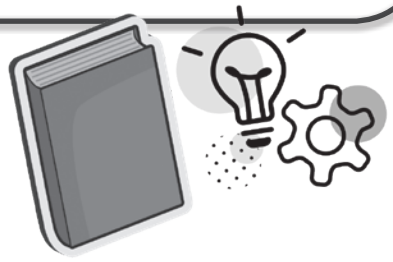
During Reading

Research and Brainstorm

1. Distribute the *Saving the Arctic* books to students. Read pages 4–9 aloud. Pause periodically to help students make inferences about the text. For example, on page 6, invite students to make an inference based on the sentence "Polar bears, fish, seals, sharks, and whales all share this icy home." Guide students by asking them whether all animals could survive in the Arctic. Explain that because you know the Arctic has harsh conditions, you may infer that these animals have adaptations that help them survive these conditions.
   - Display the Interactiv-eBook for a more digitally enhanced reading experience. You may wish to have students annotate the PDFs as you read.
   - Play the audio recording as students follow along to model fluent reading. This may be done in small groups or at a listening station. The recording will help **English language learners** practice fluency and aid in comprehension.
2. Distribute *Using Clues to Infer* (page 10) to students. Have students read the books in pairs. Ask them to use text clues with their prior knowledge to make inferences on the activity sheets as they read.
   - Provide **below-level learners** with text clues given in the *Answer Key* (page 2) to make inferences.
3. Have students record their ideas for designs on their *Make a Plan* activity sheets.

After Reading

1. Write the vocabulary words on the board and review their definitions. Then, have students write a riddle for one of the words. For example, a riddle for the word *permafrost* might be, "I am a mix of frozen soil and water. Many homes in the Arctic are built on top of me. What am I?" Have students take turns saying their riddles and guessing the correct answers. Ask students to walk around and meet five other riddles before sitting down.
2. Tell students that written accounts of events and experiences can provide valuable scientific and historic resources. Remind students how the Inuit people are helping scientists learn about the changes happening in the Arctic by providing eyewitness accounts and recording observations of climate changes.
3. Distribute *Eyewitness to Change* (page 11) to students. Ask them to use details from the text to plan journal entries to record their observations about how life is changing in the Arctic from the perspective of an Inuit. Tell students their observations could be about the animals, land, and surrounding oceans.
4. Have students use their graphic organizers to write journal entries on separate sheets of paper. Ask them to include drawings of something they witnessed that shows evidence of a changing climate.



Saving the Arctic (cont.)

Prep

- Review all designs prior to building.
- Prepare all materials for the STEAM Challenge.
- Prepare one sample permafrost layer by freezing water and/or soil in a medium-sized foil pan.

STEAM Challenge

Design and Build

1. Discuss the following questions as a class to connect the reading to the STEAM Challenge:
   - *What is permafrost?* Have students recall that permafrost is frozen soil that contains up to 80 percent frozen water.
   - *How does melting ice affect people and animals in the Arctic?* Guide students to the idea that when ice melts and carries soil with it into the ocean, less land is available for people and animals to live on.
2. Distribute previously completed activity sheets. Review the STEAM Challenge on pages 28 and 29. List materials on the board and display the permafrost layer that they will use to test their houses.
3. Remind students that their models must remain upright, level, and undamaged as the permafrost melts. Point out that damage to a model includes removed or displaced pieces, alterations to the overall structure, and damage to the building materials caused by water.
4. Ask students to independently sketch and label two designs on their *Make a Plan* activity sheets.
5. Organize students into teams. Distribute one copy of *Collaborative Design* (page 12) to each team. Ask teams to have members share their designs. Then, have groups choose, sketch, and label a team design. (Team designs must be submitted for approval before building.)
   - Challenge **above-level learners** by adding constraints or criteria (e.g., the structure must be a certain height, it must have at least two stories).
6. Explain to students that when they build their models, they must follow their design plans. Allow students to use scales to weigh houses during the building phase to make sure that their structures meet the 0.5 kilogram (1 pound) weight constraint. Reassure them that they will have an opportunity to change and improve their designs after they present and test them. Review classroom expectations for working with materials. Give teams time to build models.
   Note: If testing on another day, remove structures from pans and return permafrost to freezer.
   - You may choose to digitally record students' processes to share at a later date with students and parents.
7. Distribute *Think about It* (page 13) to students. Explain that reflection is an important part of the engineering design process. Read aloud questions 1 and 2 on the activity sheets and have students write their responses. Ask volunteers to share.

Saving the Arctic (cont.)

Prep

- Review all designs prior to building.
- Prepare all materials for the STEAM Challenge.
- Prepare a permafrost layer for each team by freezing water and/or soil in medium-sized cake pans.
- Prepare a testing area, either outdoors in a sunny area or under heat lamps.

STEAM Challenge

Test and Improve

1. Discuss the following questions as a class to connect the reading to the STEAM Challenge:
   - *Why is melting permafrost a concern for people living in the Arctic?* Guide students to recall that since many homes are built on permafrost, the structures may become damaged when the permafrost melts.
   - *What solutions have scientists found to help save the Arctic?* Have students recall solutions discussed in the text, such as placing bags of gravel along the shoreline, using fewer fossil fuels, and using more energy powered by nature.
2. Before testing models with heat, distribute cake pans filled with frozen water or soil to each team. Allow teams 10 minutes to make any adjustments to their models before testing. Explain that teams will offer feedback after the test. Use *Friendly Feedback* (page 14) to review best practices for giving feedback.
3. Distribute *Model House Test Results* (page 15) to students and ask them to record results for their team's models.
4. Gather teams to test their models, either outdoors in a sunny area or under a heat lamp. Allow time for teams to test. Then, have students place the model on the frozen layer. Have students observe their team's models for 20 minutes in the sun or under a heat lamp. A successful model will fit inside the pan, weigh at least 0.5 kg (1 lb.), and remain upright, level, and undamaged as the permafrost melts.
5. Invite each team to share their results with the class. Ask volunteers to give friendly feedback.
6. Allow time for teams to brainstorm ways to improve their designs based on test results and feedback. Refer students back to their *Collaborative Design* activity sheets. Ask them to sketch their improved designs and explain any changes. Have students submit improved designs for approval before building.
   - Challenge **above-level learners** and/or successful teams with additional constraints or criteria for the second design (e.g., add weight to the house, increase the height of the structure).
7. Have teams gather materials to improve their designs. Then, have them retest their structures.
8. Have students answer questions 3 and 4 on their *Think about It* activity sheets.

Saving the Arctic (cont.)

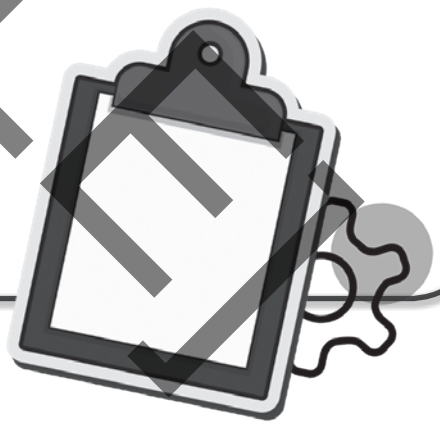
STEAM Challenge

Reflect and Share

1. Ask half the class to form a circle facing outward. Then, have the other half form a circle facing them, creating inner and outer circles.
2. Have students reflect on their STEAM Challenge experiences by asking a question from the *Think about It* activity sheet. Have students discuss their responses with the person in front of them. Ring a bell or give students a signal for the outside circle to rotate one person to the left. Repeat this activity with the rest of the questions or create your own.
3. Have students answer question 5 on their *Think about It* activity sheets.
4. Distribute *Engineering Design Process* (page 16) and review how students used the steps to complete the challenge. Have them annotate the infographics with details specific to this challenge.
5. Read "Career Advice" on page 32 of the book. Ask students to brainstorm other tips for careers that study the Arctic.

Assessment Activities

1. Have students complete the short posttest, *Saving the Arctic Quiz* (page 17), to assess the lesson's objectives.
2. Students may complete the Interactiv-eBook activities in the Digital Resources for assessment purposes.
3. Have students complete *Teamwork Rubric* (page 18) and *Engineering Design Process Checklist* (page 19) to reflect on and evaluate their work and collaboration skills.
4. Have students complete the Read and Respond questions from the book. Possible answers to the questions can be found in the Digital Resources (arctic_reproducibles.pdf).



Name: _____ Date: _____

Make a Plan

Directions: Summarize the challenge. Brainstorm ideas and sketch two designs. Circle your favorite.

Challenge: _____

_____

_____

Brainstorm

Design 1

Design 2

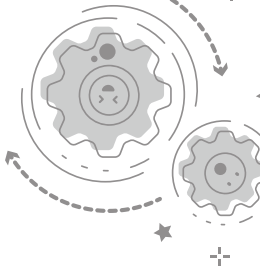
Name: _____ Date: _____

Using Clues to Infer

Directions: Use clues from the text and your prior knowledge to make inferences about the text.

Text Clue	What I Know	What I Infer
As the ice melts, both seals and polar bears have to change their ways.		

Name: _____ Date: _____



Eyewitness to Change

Directions: Imagine you are an Inuit child. Read the introduction. Then, write a journal entry about changes happening to your home. Then, write a conclusion.

Introduction: I am an Inuit living in the Arctic region of Greenland. I have noticed many changes lately to our home. The date today is _____.

Observations:

- _____
  _____
  _____
- _____
  _____
  _____
- _____
  _____
  _____

Conclusion:

_____
_____
_____
_____

Team Members: _____

Date: _____

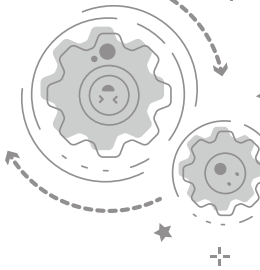
Collaborative Design

Directions: Sketch your team's design in the first box. Sketch your team's improved design in the second box. Label each design with materials needed and the purpose of each part.

Design 1

Design 2

Name: _____ Date: _____



Think about It

1. What did your team struggle with? How did you deal with it? _____

_____

_____

_____

2. How did you contribute to your team? _____

_____

_____

_____

3. How did you use science, technology, engineering, the arts, and/or math in your designs? _____

_____

_____

_____

4. What was successful about your first design? How did you improve it? _____

_____

_____

_____

5. What is the most important thing you learned? What questions do you still have?

_____

_____

_____

_____

Name: _____ Date: _____

Friendly Feedback

Directions: Feedback can help people improve their work. Use these sentence stems to give feedback to your peers.

Clarify

Can you explain _____ ?

Why did you choose to _____ ?

How did you _____ ?

Warm Feedback

I like _____ because _____ .

It is interesting that _____ .

_____ is a good idea because _____ .

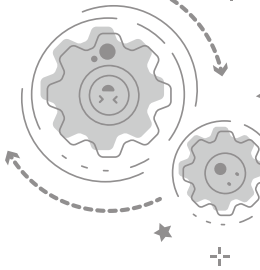
Cool Feedback

Have you thought about _____ ?

I wonder if _____ .

You might want to try _____ .

Name: _____ Date: _____



Model House Test Results

Directions: Record the height and weight of your team's house. Write at least two observations every five minutes during the test. Check boxes to tell whether the model met the criteria. Then, answer the questions.

House Measurements	
Height: _____	Weight: _____

Time (minutes)	Observations	Test Results
5		❑ remains upright ❑ remains level ❑ house is undamaged
10		❑ remains upright ❑ remains level ❑ house is undamaged
15		❑ remains upright ❑ remains level ❑ house is undamaged
20		❑ remains upright ❑ remains level ❑ house is undamaged

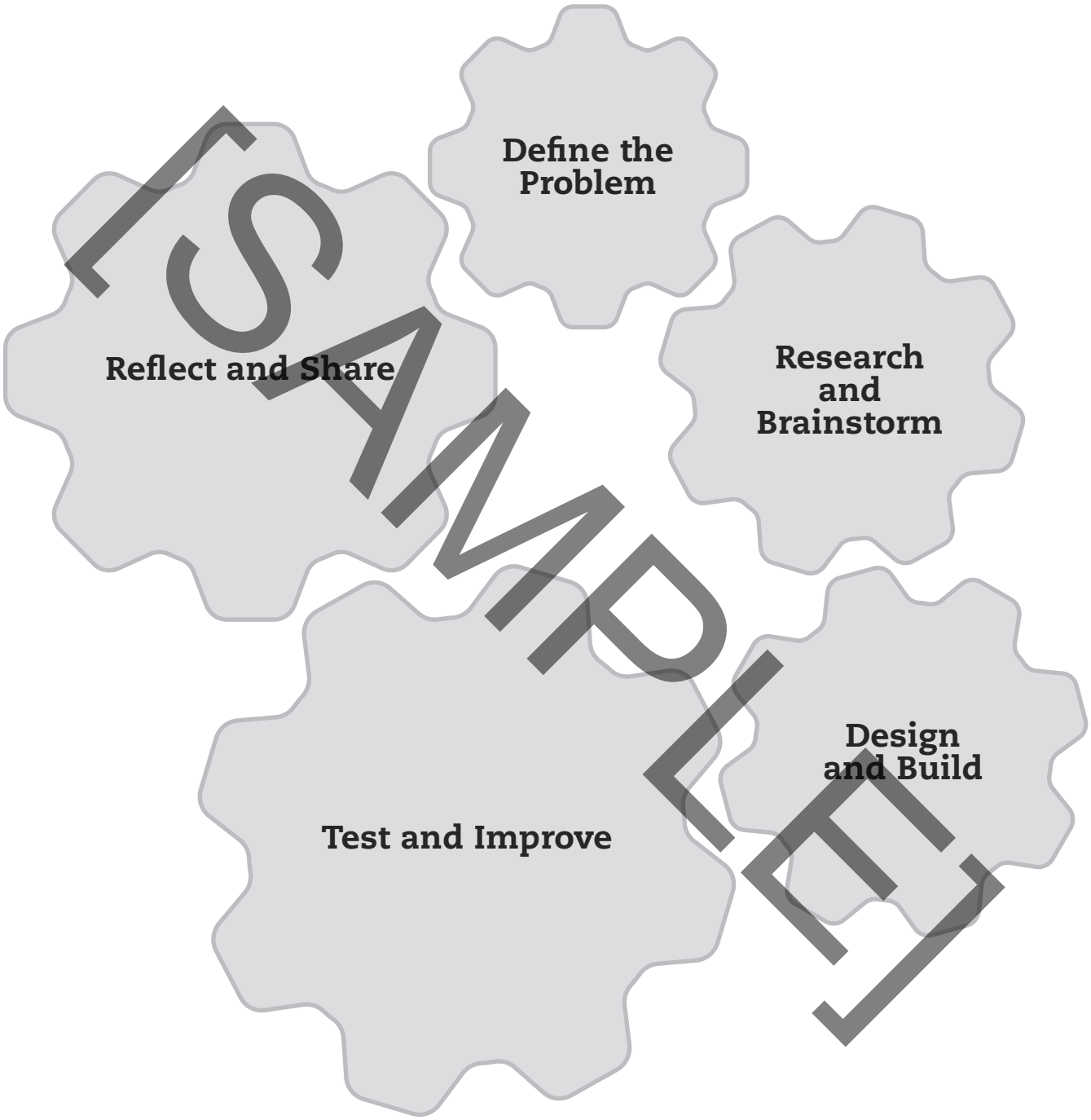
Based on other team's results, does height or weight of the house affect the results?

_____

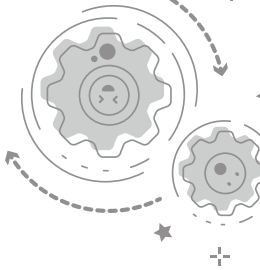
_____

Name: _____ Date: _____

Engineering Design Process



Name: _____ Date: _____



Saving the Arctic Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen. Answer the last question in complete sentences.

1. What can be inferred from the sentence, "Everything in the Arctic is connected!"

- (A) Some plants and animals can only be found in the Arctic.
- (B) Animals require water, food, and shelter to survive.
- (C) If one Arctic species is in danger, it affects other species as well.
- (D) Plants, animals, and nonliving things don't work together.

2. Readers make inferences to:

- (A) draw conclusions based on facts.
- (B) summarize an author's points.
- (C) display results from a scientific investigation.
- (D) compare and contrast two topics from a text.

3. What can be inferred from the sidebar "Kite Sledding" on page 13?

- (A) Seals rest and live on sea ice.
- (B) The sled moves about 9.7 km (6 mi.) per hour.
- (C) Scientists built a sled that is pulled by a giant kite.
- (D) Weather conditions in Greenland are often windy.

4. Rising temperatures in the Arctic are causing _____ to melt.

- (A) ecosystems
- (B) permafrost
- (C) tundra
- (D) climate

5. How are scientists helping to save the Arctic?

_____

_____

_____

Name: _____ Date: _____

Teamwork Rubric

Directions: Think about how you worked in your team. Score each item on a scale of 1 to 4.

4 = Always 3 = Often 2 = Sometimes 1 = Never

I listened to people on my team.	4	3	2	1
I helped people on my team.	4	3	2	1
I shared ideas with people on my team.	4	3	2	1
We made choices as a team.	4	3	2	1
Total				

Comments: _____

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Engineering Design Process Checklist

Directions: Check the boxes to show that you completed each step.

Define the Problem

- ❑ I understood and explained the problem in my own words.

Research and Brainstorm

- ❑ I used research to help me brainstorm solutions.

Design and Build

- ❑ I planned and made a model.
- ❑ I thought like a mathematician.

Test and Improve

- ❑ I used criteria to evaluate designs.
- ❑ I improved designs based on test results.
- ❑ I thought like a mathematician.

Reflect and Share

- ❑ I shared my results and reflected on my work.

STEAM CHALLENGE

Define the Problem

When permafrost melts, the ground becomes soft and mushy. This sometimes damages houses and buildings built on it. Your task is to create a model house that can withstand melting of permafrost.

Constraints: The base of your house must fit inside a cake pan. It must weigh at least a $\frac{1}{2}$ kilogram (1 pound).

Criteria: Your house must remain upright, level, and undamaged as the permafrost melts.

1 Research and Brainstorm

What happens when frozen soil melts? What types of materials could provide support in multiple weather conditions? Will you need to add any extra supports to your structure?

2 Design and Build

Sketch a model of your house. Decide what materials will work best. Build your model.

3 Test and Improve

Place your model in a cake pan filled with frozen mud or ice. Place it under a heat lamp or out in the sun. Observe the movement of the building as the frozen layer begins to melt. Did your structure move? Did your structure become damp or weakened? Modify your design and try again.

4 Reflect and Share

What materials worked best? How might a building that was built on actual permafrost act differently than your model? Consider other solutions. Which might work best?

Teacher Created Materials PUBLISHING

SHELL EDUCATION

"Thank you for helping us create a world in which children love to learn!"