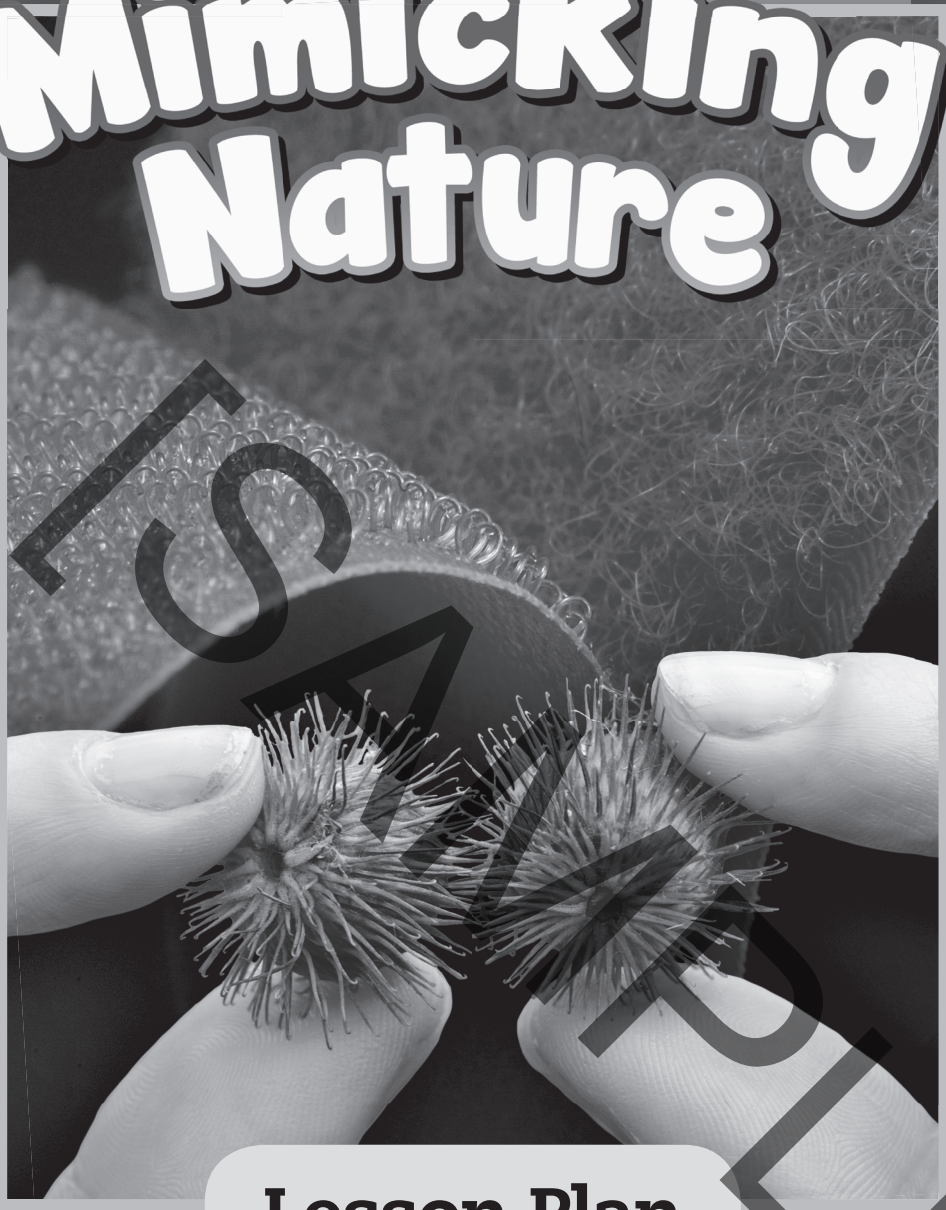
Mimicking Nature



Unit 5
The Natural World

Lesson Plan

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Smithsonian STEAM Readers

Science ■ Technology ■ Engineering ■ Arts ■ Mathematics

Teacher Created Materials PUBLISHING

5301 Oceanus Drive
Huntington Beach, CA 92649
www.tcmpub.com

TCM 28998 (i21015)
ISBN 978-1-4938-6783-7

Smithsonian

ISBN-13: 978-1-4938-6783-7
90000
9 781493 867837

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Answer Key: *Mimicking Nature*

page 10—Quiz Questions

Student questions and answers will vary based on the question words they choose and the section of text they focus on.

page 11—A Closer Look

Student responses will vary depending on the plant or animal chosen.

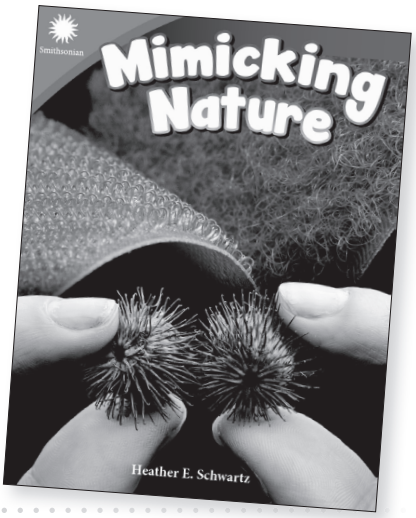
page 17—*Mimicking Nature* Quiz

1. C
2. A
3. D
4. D
5. The bottom of the machine has small hairs like those on bees to grab and hold onto pollen.

Mimicking Nature

Materials

- *Mimicking Nature* books
- copies of student activity sheets (pages 9–19)
- sticky notes (6 per student)
- **STEAM Challenge materials include but are not limited to the following:**
  - ✓ dirt
  - ✓ flowers
  - ✓ leaves
  - ✓ pinecones
  - ✓ stems
  - ✓ sticks
  - ✓ vines
  - ✓ washers



Learning Objectives

- **Reading:** Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text.
- **Writing:** Recall information from experiences or gather information from provided sources to answer a question.
- **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

Plants and animals have specialized structures and functions that help them survive.

Lesson Timeline

Day 1	Day 2	Day 3	Day 4	Days 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 ask and answer questions based on the text.	Research nature's solutions and how humans are mimicking them to solve problems, ask and answer questions about the text, and brainstorm design solutions.		Make observations about plants or animals and what can be learned from them.	Design, build, test, improve, reflect on, and share bridges. Complete the assessments.

Mimicking Nature (cont.)

STEAM Vocabulary

artificial biomimicry burrs drought inspired

Introductory Activity

Define the Problem

1. Perform an action such as touching your toes. Encourage students to copy you. Repeat several times with other actions, such as reaching for the sky, touching your knees, and turning around. Explain that to *copy* is to *mimic*.
2. Ask students to think of something in nature that an airplane was probably mimicked after (bird). Tell students they will investigate other things in nature that have been mimicked by scientists to make things.
3. Distribute the *Mimicking Nature* books to students. Read aloud to students the STEAM Challenge on pages 28–29.
   - Display the Interactiv-eBook for a more digitally enhanced introduction to the challenge.
4. Distribute *Make a Plan* (page 9) to students. Have students turn and talk to partners to summarize the STEAM Challenge. Write the following questions on the board to help students as they discuss the challenge: *What do you need to do? What can you use?*
   - **Support** students with the following sentence frame to help them summarize: *Design and build a _____ using _____.*

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 the vocabulary words on the board. Have students discuss what they think the words mean and where they may have heard them before. Explain the meaning of each word. Show students pictures related to the words, if possible. Pictures from the book may be used. Use gestures to represent the words, or use the words in sentences that provide context for the meanings of the words.
2. Write the following related words on the board: *computer, seeds, nature, slow,* and *create*. Ask students which words relate to each vocabulary word. Accept any grouping as long as students can provide logical explanations.
3. Tell students that as they read a text, one way they can monitor their understandings to ask questions as they read. Review the main types of questions: *who*, *what*, *when*, *where*, *why*, and *how*.
4. Distribute six sticky notes to each student, and ask them to write one questioning word on each sticky note. Then, ask students to preview the text and write six questions, one for each questioning word, and stick them in their books.

Mimicking Nature (cont.)

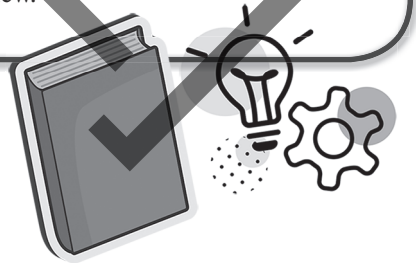
During Reading

Research and Brainstorm

1. Distribute the *Mimicking Nature* books to students. Read the text aloud as students follow along. Stop at the end of page 4, and ask students if any of their questions were answered on this page. Ask them if any other questions were answered on this page, even if they did not write them on sticky notes. Provide teacher-generated questions if needed, such as: *Where do engineers get inspiration? What are some examples of how things in nature can be used by people? Why do scientists invent new things?*
   - 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 serve as a model of 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 *Quiz Questions* (page 10) to students. Assign or have each student choose a chapter on which to focus. Encourage students to work together in pairs to create three quiz questions and write responses based on the text. Students can answer their own questions, or they can exchange their questions with other groups and respond to each other's questions.
3. Have students discuss ideas for the STEAM Challenge in their small groups. Encourage them to think about what thing in nature their bridge could act or look like (e.g., mountains, leaves, snakes, vines, or waves). Then, have them independently record ideas on their *Make a Plan* activity sheets.

After Reading

1. Review vocabulary words by doing a carousel activity. Create five stations around the room: definition, sentence, related words, picture, and example. Place students in small groups, and assign each group a vocabulary word. Have groups rotate to each station and complete the task at that station for their assigned word. Once all the groups have been to each station, discuss the words as a group.
2. Read the Career Advice on page 32 of *Mimicking Nature*. Explain to students that professionals in STEAM fields are sometimes interviewed about their work. Tell them that this is one way that people share important research and work they are doing with others in their field and the public.
3. Distribute *A Closer Look* (page 11) to students. Take a quick field trip outside, and ask students to identify plants or animals to study closely. Have each student write or draw about the plant or animal they choose on one side of the activity sheet. Then, have students identify ways the plants or animals have already been inspirational to scientists. Or have students identify ways the plants/animals could be inspirational to make something new.



Mimicking Nature (cont.)

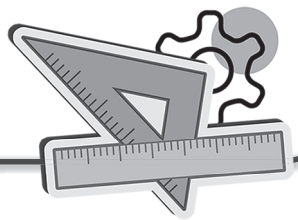
Prep

- Review all designs prior to building.
- Prepare all materials for the STEAM Challenge.

STEAM Challenge

Design and Build

1. As a group, discuss the following questions to connect the reading to the STEAM Challenge:
   - *How can leaves inspire engineers to build better bridges?* Have students refer to pages 14 and 15 to review what the book says about lotus leaves. You may choose to find images of Wanda Lewis's bridge designs online to show students.
   - *What other plants and animals described in the book could be inspiration for building a bridge?* Encourage students to share their ideas and support them with examples or reasons.
2. Distribute previously completed activity sheets. Review the STEAM Challenge on pages 28–29 together. List materials on the board, and show students samples of the materials so they get a better understanding of what they have to work with. Allow students to hold the five washers in their hands so they know the weight their bridges must support.
3. Ask students to independently sketch and label two designs on their *Make a Plan* activity sheets.
4. Organize students into teams. Distribute one copy of *Team Designs* (page 12) to each team. Ask teams to have members share their designs. Then, have each team choose, sketch, and label a team design. (Team designs must be submitted for teacher approval before building begins.)
   - **Challenge** students by adding constraints or criteria (e.g., all five washers must be in the center of the bridge, increase the number of washers).
5. Explain to students that when they build their models, they must follow their design plans. Reassure students that they will have an opportunity to change and improve their designs after they present them. Review classroom expectations for working with materials. Then, give teams time to gather materials and build their bridges.
   - Digitally record students' processes to share at a later date with students and parents.
6. Distribute *Think about It* (page 13) to each student. Explain that reflection is an important part of the engineering design process. Read aloud numbers 1 and 2 on the activity sheet, and have students write their responses. Ask volunteers to share.



Mimicking Nature (cont.)

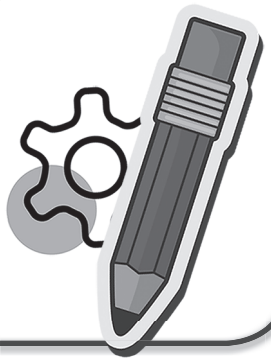
Prep

- Review all designs prior to building.
- Prepare all materials for the STEAM Challenge.

STEAM Challenge

Test and Improve

1. As a group, discuss the following questions to connect the reading to the STEAM Challenge:
   - *What is one thing scientists created that was inspired by lotus leaves?* Guide students to discuss how lotus leaves' ability to repel water inspired people to create solar panels that stayed clean in different weather. Encourage students to understand that things in nature can serve as inspiration for different purposes.
   - *How did George de Mestral look at burrs in a different way?* Have students recall that de Mestral looked closely at the burrs to see what was causing them to stay attached to his dog. Encourage students to think about different ways they can look at the natural materials they used to build their bridges and at the bridge itself.
2. Gather teams for testing. Explain that teams will offer feedback after the test. Use *Friendly Feedback* (page 14) to review best practices for giving feedback.
3. Distribute *Nature Bridge Test Results* (page 15) to students, and ask them to record results for each team.
4. Gather teams to test their bridges. Have one student from each team place the washers on the team's bridge, one washer at a time. Unless constraints were placed on the teams during building, students can place washers on any part of the bridge. Ask volunteers to give friendly feedback for each bridge.
5. Provide time for teams to brainstorm ways to improve their designs based on test results and feedback. Refer students back to their *Team Designs* activity sheets. Ask them to sketch their improved designs and explain any changes. Have students submit improved designs for approval before building.
   - **Challenge** successful teams with additional constraints or criteria for the second design (e.g., build the bridge to be at least a certain number of inches long, or have the bridge hold more weight, use fewer materials).
6. Have teams gather materials to improve their designs. Then, have them make their improvements and retest their bridges.
7. Have students complete numbers 3 and 4 on their *Think about It* activity sheets.



Mimicking Nature (cont.)

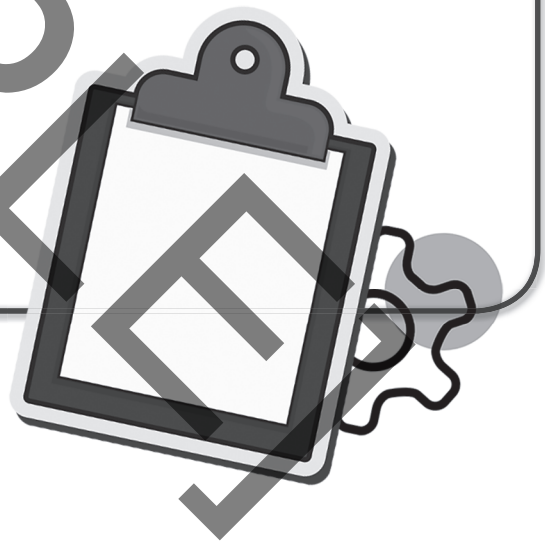
STEAM Challenge

Reflect and Share

1. Write four actions on the board (e.g., jumping jacks, toe touches, jog in place, marching in place). Have students choose one of the actions and begin performing it. As students are performing it, have them look around to find partners who are mimicking the same action they are. When students make eye contact with another person, they become partners. Have partners share their answers from 1–4 from their *Think about It* activity sheets. Then, have pairs of students join together to make quads. Encourage students in each quad to share the discoveries they made while reading the book and performing the challenge.
2. Have students answer question 5 on their *Think about It* activity sheets.
3. Distribute *Engineering Design Process* (page 16), and review how students used each step to complete the challenge. Have them annotate the infographic with details specific to this challenge.
4. Read "Career Advice" on page 32 of the book. Ask students to brainstorm other tips for a career in biomimicry.

Assessment Activities

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



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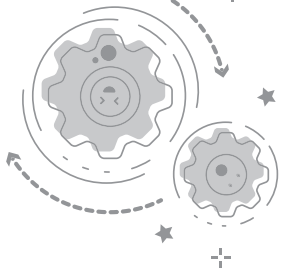


Make a Plan

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

Challenge: _____

_____

Brainstorm

Design 1

Design 2

Name: _____ Date: _____

Quiz Questions

Directions: Write three questions about *Mimicking Nature*. Then, locate the answers in the text, and write responses to your questions.

Question Word Bank

who	what	where
why	when	how

Question	Response
1.	
2.	
3.	

Name: _____ Date: _____

A Closer Look

Directions: Go outside and find a plant or animal to study. Draw or write about it in the left column. Then, draw or write about what it could inspire scientists to create in the right column.

Plant or Animal Studied	Inspiration

Team Members: _____

Date: _____

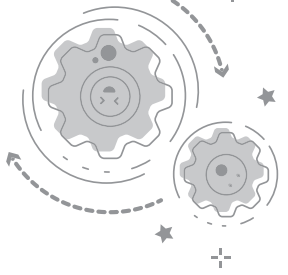
Team Designs

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. It was (hard/easy) to create one team design because _____

_____

_____.

2. I helped my team by _____

_____.

3. Our design (failed/passed) the test because _____

_____.

To improve our design, we _____

_____.

4. Our improved design (worked/did not work). I know this because _____

_____.

5. During this challenge, I learned _____

_____.

My favorite part was _____

_____.

Name: _____ Date: _____

Friendly Feedback

Directions: Feedback from others 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 _____ .

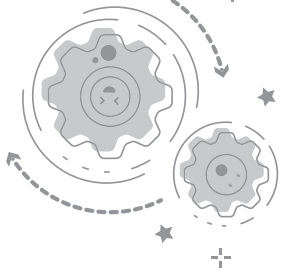
Cool Feedback

Have you thought about _____?

I wonder if _____ .

You might want to try _____ .

Name: _____ Date: _____



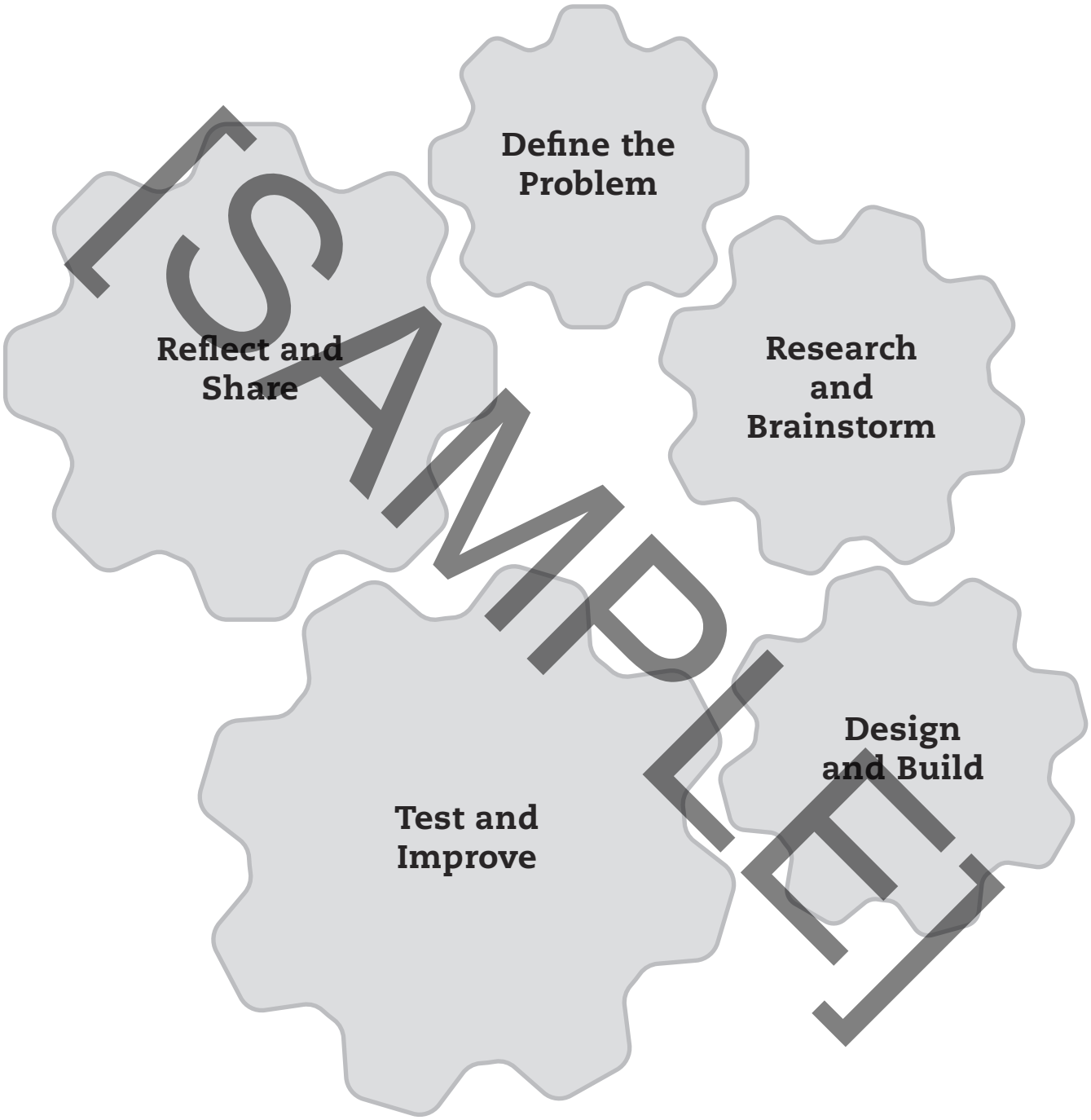
Nature Bridge Test Results

Directions: Write the materials each team used. Write one thing that worked well in each team's design.

Team	Materials	What worked well in the design?

Name: _____ Date: _____

Engineering Design Process



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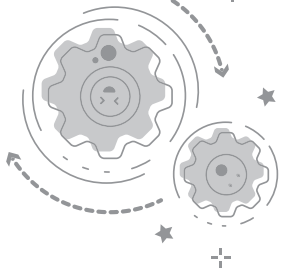


Mimicking Nature Quiz

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

1. What does *inspired by nature* mean?

- (A) scientists preserve nature
- (B) nature changes
- (C) scientists study nature for ideas
- (D) scientists plant more trees

2. In the book, why did scientists study cacti?

- (A) to learn about how the cacti save water
- (B) to learn about how the thorns scare away birds
- (C) to learn about how cacti are waterproof
- (D) to learn how burrs stick to things

3. What plant inspired the starshade?

- (A) lotus leaf
- (B) pine tree
- (C) burrs
- (D) sunflower

4. Bacteria that cause cholera can be stopped by _____.

- (A) waterproof lotus leaves
- (B) thorns on prickly pear cacti
- (C) dirty food and water
- (D) a seaweed found in the ocean

5. How do bees inspire machines that can pollinate?

_____

_____

_____

Name: _____ Date: _____

Teamwork Rubric

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

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				

What is one thing your team did well? _____

_____

_____

What could your team do better next time? _____

_____

_____

Name: _____ Date: _____

Engineering Design Process Checklist

Directions: Check the boxes to show that you did 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

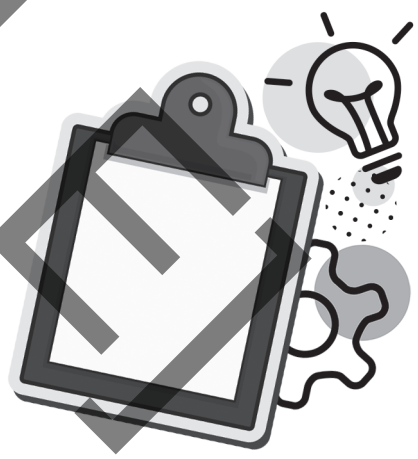
- ❑ I planned and made a model.
- ❑ I thought like a mathematician or an engineer.

Test and Improve

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

Reflect and Share

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



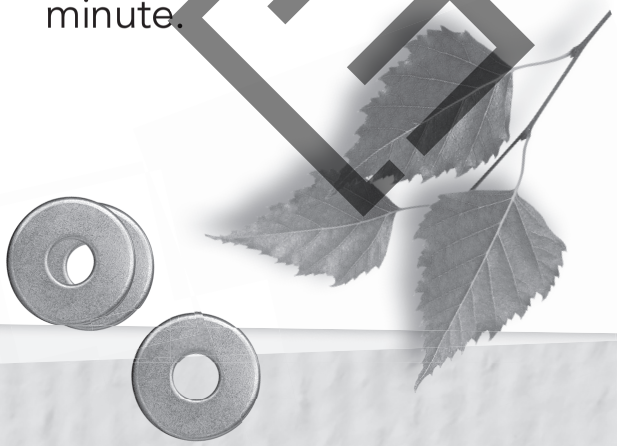
STEAM CHALLENGE

Define the Problem

You have been asked to build a model of a bridge. Your bridge must be built to look or act like something in nature. It must be able to stand on its own and support weight.

Constraints: Your bridge must only use things that are found in nature, such as leaves, flowers, and twigs.

Criteria: Your bridge must support five washers for one minute.



1 Research and Brainstorm

What is biomimicry? How has nature inspired new ideas? What natural items might make your bridge strong enough to support weight?

2 Design and Build

Sketch the design of your bridge. What purpose will each part serve? What materials will work best? Build the model.

3 Test and Improve

Place five washers anywhere on your bridge. Let them stay for one minute. Did your bridge work? How can you improve it? Improve your design, and try again.

4 Reflect and Share

Which materials were the strongest? What items can you add to make your bridge more successful? How might your design change if it needed to be waterproof?