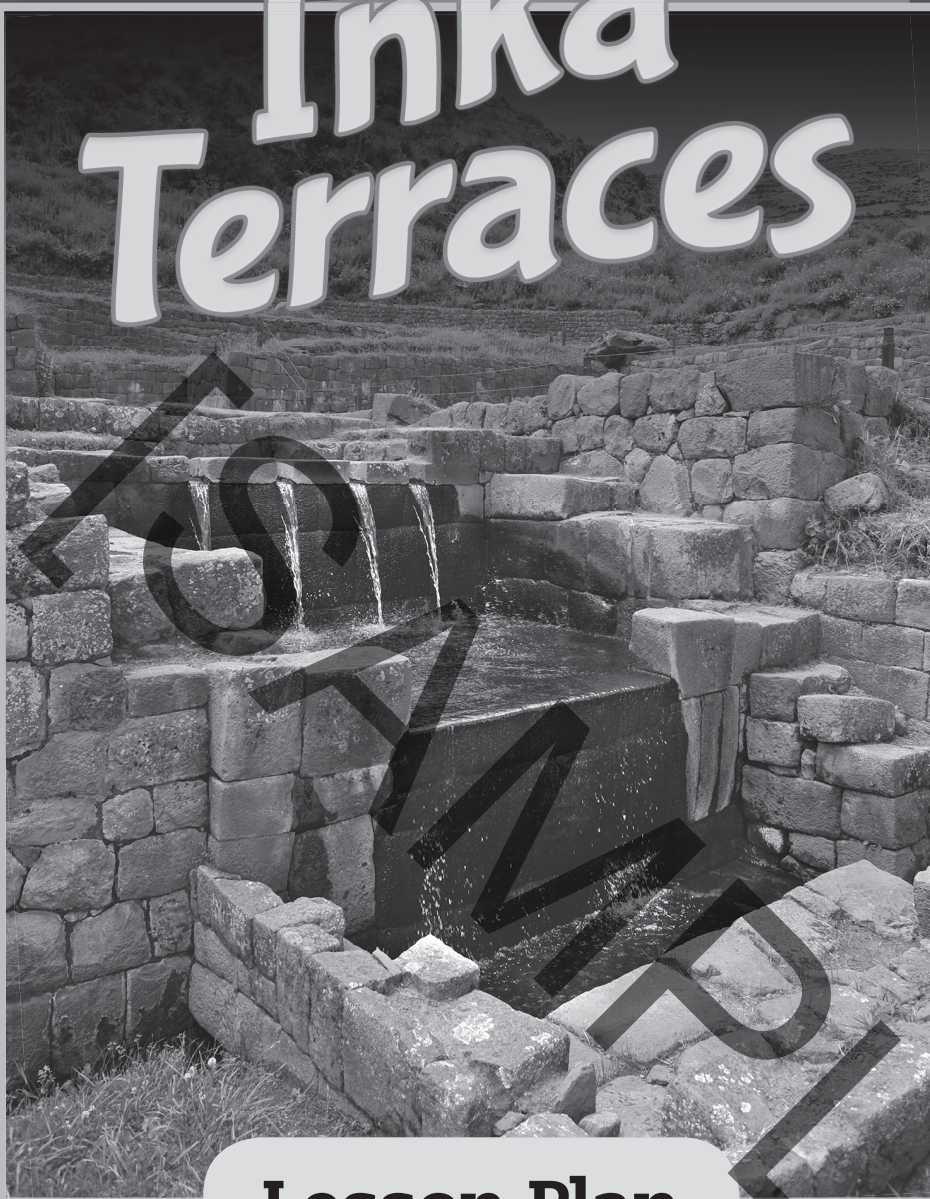


Inka Terraces



Unit 2
History
& Culture



Lesson Plan

Author

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Smithsonian

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Answer Key: Inka Terraces

page 10—Using The Text to Infer

Responses will vary. Example:

Machu Picchu: "It is almost like the terraces pin down the mountain, holding it in place." (page 15); If the Inka did not include terraces in their building design, the ancient ruins at Machu Picchu might not have survived.

Tipón: "A big splash at the bottom would waste water and hurt the overall artistic effect of calm and control." (page 22); When the Inka designed structures, they considered both efficiency and beauty.

Moray: "For now, Moray remains a beautiful mystery." (page 25); There is still more to learn from the Inka, and people are still trying to study and learn their methods.

page 11—Learning from the Inka

Responses will vary. Example:

Materials: The Inka used stones to build the terrace walls. They filled the area behind the walls with layers of rocks, gravel, sand, and rich soil. Today, some people use tires to build terraces.

Benefits: Terraces provide flat and fertile land to grow crops. Terraces prevent erosion during heavy rain. Archaeologists discovered that heat stored in stone walls can protect plant roots from the cold at night.

I think that erosion prevention is the most important benefit of terrace farming. It helps keep fertile soil and seeds in place.

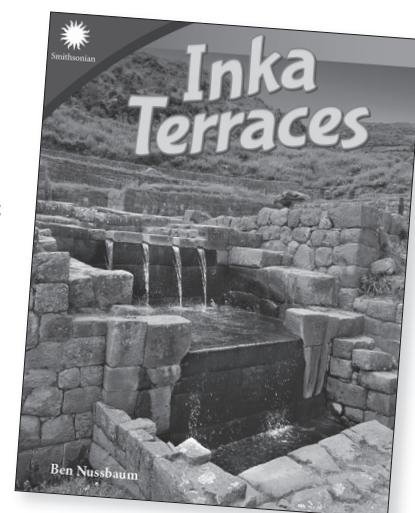
page 17—Inka Terraces Quiz

- | | |
|------|---|
| 1. B | 4. C |
| 2. A | 5. Responses will vary. Example: Archaeologists are interested in preserving what the Inka built so that they can learn from ancient ways of farming and controlling water. They are using old methods to help inform current farming techniques. |
| 3. A | |

Inka Terraces

Materials

- ▶ *Inka Terraces* books
- ▶ copies of student activity sheets (pages 9–19)
- ▶ sticky notes (1 per student)
- ▶ **STEAM Challenge materials include but are not limited to the following:**
 - ✓ 1-liter of water
 - ✓ cardboard pieces
 - ✓ cookie sheets
 - ✓ modeling clay
 - ✓ plant material (e.g., moss, grass, leaves)
 - ✓ rocks and pebbles
 - ✓ sand
 - ✓ soil
 - ✓ sticks, various sizes
 - ✓ watering can



Learning Objectives

- ▶ **Reading:** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- ▶ **Writing:** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- ▶ **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

Water travels downward due to gravity, moving Earth materials as it flows.

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 practice making inferences.	Research Inka terraces, make inferences and support them with evidence, and brainstorm design solutions.		Gather and sort information about the materials and benefits of terrace farming.	Design, build, test, improve, reflect on, and share models of layered terrace systems. Complete the assessments.

Inka Terraces (cont.)

STEAM Vocabulary

archaeologists

erosion

fertile

irrigation

reservoirs

Introductory Activity

Define the Problem

1. Ask students to imagine themselves as engineers who have been assigned to help farmers find ways to grow crops in a mountainous area. Encourage students to consider materials they may use to modify the landscape, such as rocks, clay, and soil. Divide the class into pairs, and have them discuss and record their ideas. Invite students to share their plans with the class.
2. Distribute the *Inka Terraces* books to students. Reveal the STEAM Challenge by reading aloud 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.
3. 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 model of a _____ that will allow _____.*

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, and discuss their meanings. Write each vocabulary word on a sticky note. Place one sticky note on the back of each student. Have students walk around the room asking their classmates yes or no questions about the words on their backs. Have students sit once they have guessed correctly.
2. Tell students that an inference is a conclusion or deeper understanding that a reader makes about a text. Explain that an inference is based on the author's words but is not directly stated in the text. Point out that a reader may use text quotes to show which of the author's words were used to make an inference.
3. Write the sentence from page 4 of the *Inka Terraces* book: "Terraces gave Inka farmers flat, fertile land on which to grow their crops," on the board. Divide the class into pairs, and ask them to make inferences based on the quote. Guide students to make inferences about the landscape where the Inka lived, Inka civilization, and conditions necessary to grow crops. Invite students to share their inferences with the class, and point out that various inferences can be made about the same quote.
 - Have **below-level learners** practice making inferences based on sentences, such as: *The athletes had sweat running down their faces;* *There were no more puddles on the basketball court.*

Inka Terraces (cont.)

During Reading

Research and Brainstorm

1. Distribute the *Inka Terraces* books to students. Read pages 4–13 aloud. Pause periodically to have students identify quotes and make inferences based on the text. For example, on page 4, ask students to make an inference about the treatment of Inka royalty in their culture: “Canals even brought fresh water to the doors of Inka royalty.”
 - 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 *Using the Text to Infer* (page 10) to students. Have students read the books in pairs. Ask them to make inferences about three Inka sites in the text as they read.
3. Have students record ideas they have for their 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 riddles for one of the words. For example, a riddle for the word *erosion* might be, “I wash away soil and other earth materials. Sometimes, I cause problems for farmers in mountainous areas. What am I?”
2. Have students take turns saying their riddles and guessing the correct answer. Ask students to share their riddles with five people before sitting down.
3. Reread the following sentence on page 4 of the *Inka Terraces* book: “In the land of the Inka, people are reminded that old ways to farm may still be the best.” Explain to students that scientists, engineers, and experts in various fields often look to past methods to help plan projects and experiments. Point out that farmers in many parts of the world still use terrace farming, just as the Inka did.
4. Distribute *Learning from the Inka* (page 11) to students. Ask students to imagine that they are considering creating a simple form of a terrace to grow herbs and vegetables in their yards. Tell them that they will collect and summarize information from the text about the materials needed for and benefits of terrace farming. Have them work in pairs to complete the graphic organizers.
 - Challenge students to brainstorm a third category to record notes.

Inka Terraces (cont.)

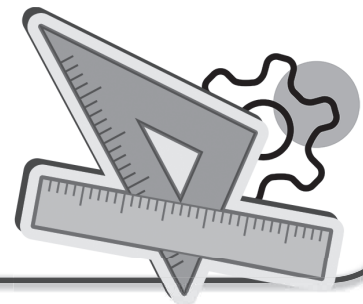
Prep

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

STEAM Challenge

Design and Build

1. As a class, discuss the following questions to connect the reading to the STEAM Challenge:
 - ▶ *What types of materials did the Inka use to build terraces?* Have students discuss different types of materials that the Inka used to build terraces, including stones, rocks, gravel, sand, and soil. Have students recall how the different materials absorb water.
 - ▶ *Why did Inka builders create vertical channels at Tipón?* Make sure students point out that Inka builders created vertical channels, or grooves built into the stone, to keep water flow straight and controlled. You may choose to refer students back to the image on page 23 for a reminder.
2. Distribute previously completed activity sheets. Review the STEAM Challenge on pages 28 and 29. List materials on the board, and show students the liter of water that will be poured on top of the system during the testing phase. Tell students that they will build their models on top of cookie sheets so that they may be transported.
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 *Collaborative Design* (page 12) to each team. Ask teams to have members share their designs. Then, have each group choose, sketch, and label a team design. (Team designs must be submitted for approval before building begins.)
 - ▶ Challenge students by adding constraints or criteria (e.g., the system must include vertical channels, water must reach all sides of the “mountain”).
5. Explain to students that when they build their models, they must follow their design plans. Reassure them 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 models.
 - ▶ Digitally record students’ processes to share at a later date with students and parents.
6. 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.



Inka Terraces (cont.)

Prep

- ▶ Review all designs prior to building.
- ▶ Prepare all materials for the STEAM Challenge.
- ▶ Prepare a large table or area for students to test their terrace systems.

STEAM Challenge

Test and Improve

1. As a class, discuss the following questions to connect the reading to the STEAM Challenge:
 - ▶ *How do farmers in the Andes experiment with crops?* Have students discuss that farmers in the Andes plant various types of crops and test where they grow best.
 - ▶ *How did Inka engineers show determination when building Machu Picchu?* Make sure student discussion highlights the fact that after the Inka spent a year or two studying the site, they spent about 90 years building Machu Picchu.
2. Gather teams for testing. Invite teams to bring their terrace systems to a large table for testing. Explain that teams will offer feedback after each test. Use *Friendly Feedback* (page 14) to review best practices for giving feedback.
3. Distribute *Terrace System Test Results* (page 15) to students, and ask them to record results for each team.
4. Allow time for teams to test their systems. Slowly pour 1 L (1 qt.) of water into the top of the terrace system. A successful model will allow 1 L (1 qt.) of water to flow through the system without spilling or overflowing before it reaches the bottom terrace. Ask volunteers to give friendly feedback.
5. Provide 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 successful teams with additional constraints or criteria for the second design (e.g., add additional terrace layers, increase the amount of water to 2 L [2.1 qt.]).
6. Have teams gather materials to improve their designs. Then, have them make improvements and retest their systems.
7. Have students answer questions 3 and 4 on their *Think about It* activity sheets.

Inka Terraces (cont.)

STEAM Challenge

Reflect and Share

1. Have students draw a side view of a three-level terrace, or three large steps, on blank sheets of paper. On the top level, ask them to write something they learned during the STEAM Challenge. On the middle level, ask them to write a question they still have. On the bottom level, ask them to write what surprised them most. Then, have students share their papers in small groups or as a class.
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 the steps to complete the challenge. Have them annotate the infographics 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 studying cultures.

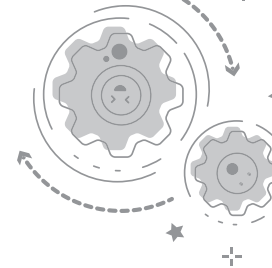
Assessment Activities

1. Have students complete the short posttest, *Inka Terraces Quiz* (page 17), to assess the lesson’s objectives.
 - Students may complete the Interactiv-eBook activities in the Digital Resources for assessment purposes.
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 ([inka_reproducibles.pdf](#)).



Name: _____

Date: _____



Make a Plan

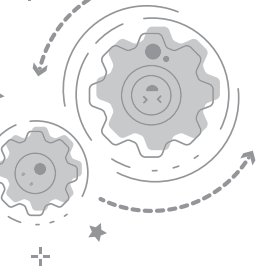
Directions: Summarize the challenge. Brainstorm ideas, and sketch two designs. Circle your favorite.

Challenge: _____

Brainstorm

Design 1

Design 2



Name: _____

Date: _____

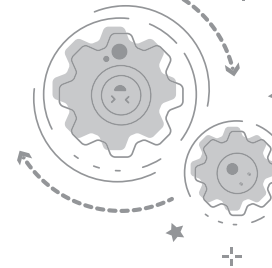
Using the Text to Infer

Directions: Find and record information from the text. Make inferences about three Inka sites based on that information.

Inka Site	Information from the Text	What I Infer
Machu Picchu		
Tipón		
Moray		

Name: _____

Date: _____



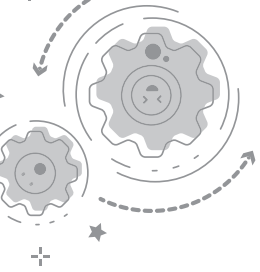
Learning from the Inka

Directions: Find and record notes about the materials and benefits of terraces. Then, answer the question.

Materials	
Benefits	

(A large diagonal watermark reading "SAMPLE" is overlaid on the table.)

What do you think is the most important benefit of terrace farming?



Team Members: _____

Date: _____

Collaborative Design

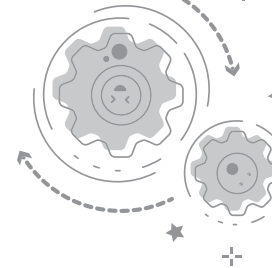
Directions: Sketch your team's design in the first box. Sketch your team's improved design in the second box. Label each design with materials needed and the purpose of each part.

Design 1

Design 2

Name: _____

Date: _____



Think about It

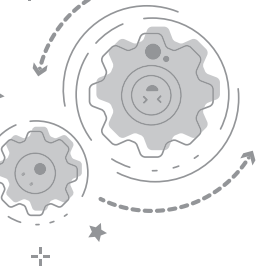
1. What did your team struggle with? How did you deal with it? _____

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

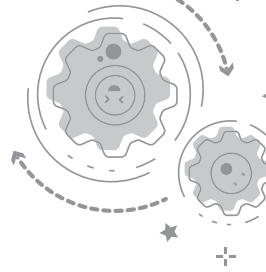
Have you thought about _____ ?

I wonder if _____ .

You might want to try _____ .

Name: _____

Date: _____

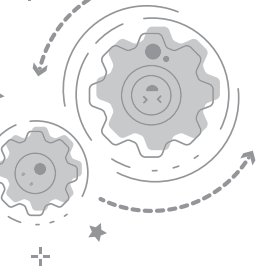


Terrace System Test Results

Directions: Record the materials each team used. Mark the results of each team's test. Describe what happened to the water in each system. Then, answer the question.

Team	Materials	Test Results	Observation of Water Flow
		<input type="checkbox"/> water flows to the bottom <input type="checkbox"/> no overflow	
		<input type="checkbox"/> water flows to the bottom <input type="checkbox"/> no overflow	
		<input type="checkbox"/> water flows to the bottom <input type="checkbox"/> no overflow	
		<input type="checkbox"/> water flows to the bottom <input type="checkbox"/> no overflow	
		<input type="checkbox"/> water flows to the bottom <input type="checkbox"/> no overflow	

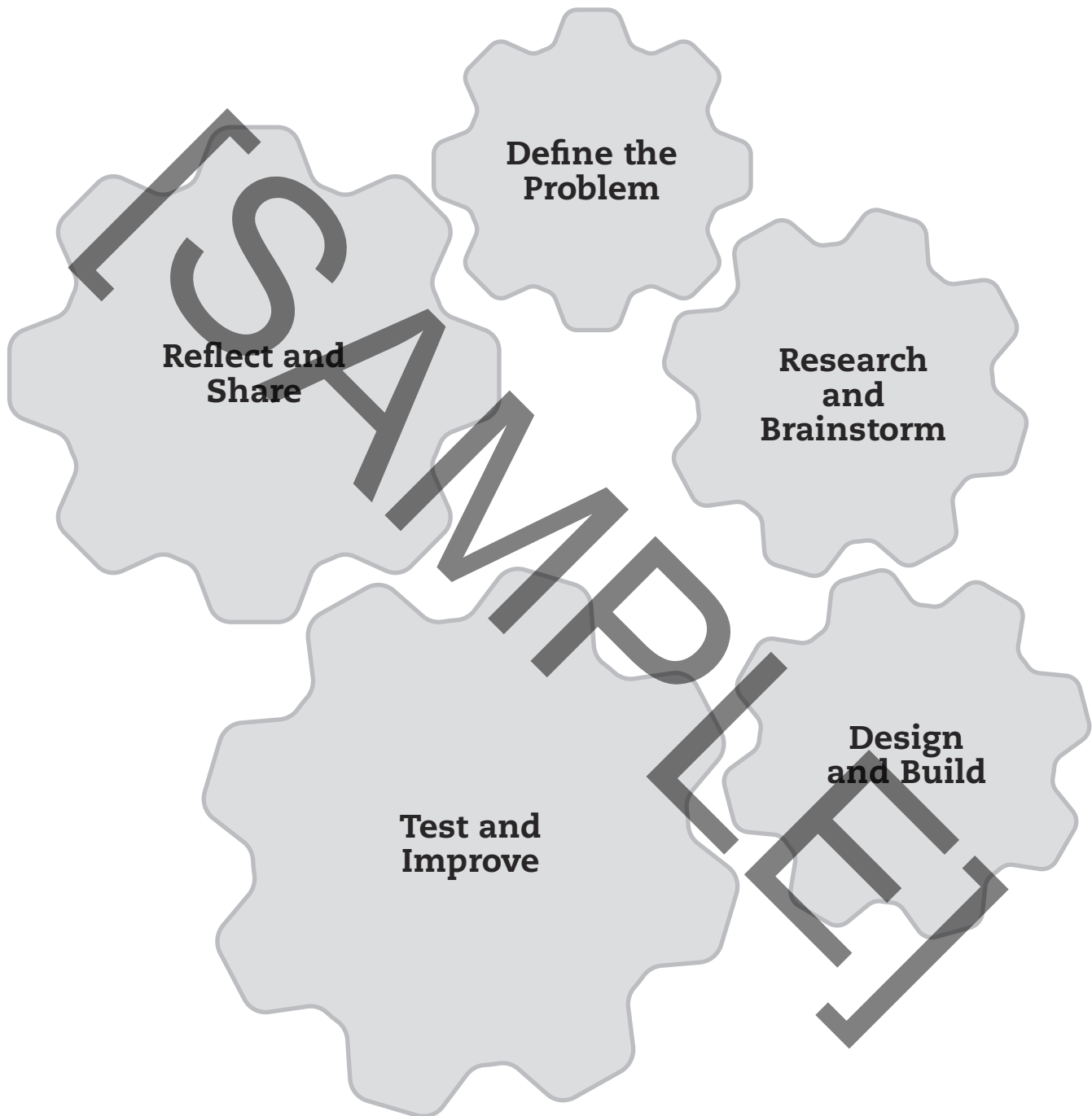
Which team's model worked best? Why?

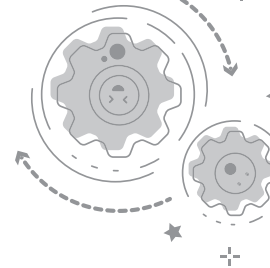


Name: _____

Date: _____

Engineering Design Process

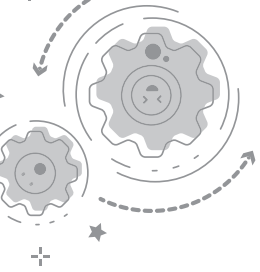




Inka Terraces Quiz

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. Which of the following can be inferred from this sentence: "Before 1911, only the people who lived nearby knew about the old stone ruins of Machu Picchu."
- ☐ (A) Machu Picchu was very large.
- ☐ (B) The location of Machu Picchu was not easily seen or accessed.
- ☐ (C) Machu Picchu never had any people living at it.
- ☐ (D) The weather at Machu Picchu was usually cold.
2. Readers make inferences to
- ☐ (A) draw conclusions about a text.
- ☐ (B) quote a text.
- ☐ (C) give an opinion.
- ☐ (D) summarize a text.
3. Which inference can be made from the sidebar "The Art of Storage" on page 19?
- ☐ (A) The Inka people were skilled artists.
- ☐ (B) Machu Picchu had 16 fountains.
- ☐ (C) It was easy for the Inka people to get fresh water at Machu Picchu.
- ☐ (D) Inka artists experimented with different drawing tools.
4. The mild climate and _____ soil produced a large crop of corn this growing season.
- ☐ (A) resistant
- ☐ (B) erosion
- ☐ (C) fertile
- ☐ (D) hydraulic
5. Why are archaeologists interested in preserving what the Inka built?
- _____
- _____
- _____
- _____
- _____



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				

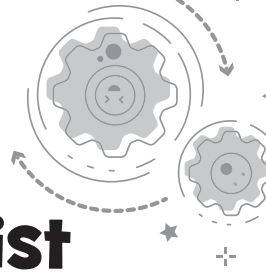
What is one thing your team did well? _____

What could your team do better next time? _____

What else do you want your teacher to know about your team? _____

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 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

Rainfall on mountain slopes moves downward and may cause mudslides and erosion. The Inka built terraces to decrease the force and to control the flow of water. Your task is to design and build a model of a layered terrace system that can hold 1 liter (about 1 quart) of water without spilling over the bottom terrace.



Constraints: Your model must include four terrace layers, and it must be able to hold 1 L (about 1 qt.) of water.

Criteria: A successful model will allow 1 L (about 1 qt.) of water to flow from the top to the bottom terrace layers. The water should not spill or overflow once it reaches the bottom terrace.



Research and Brainstorm

How did the Inka benefit from building terraces? What other techniques did Inka engineers use to manage water?



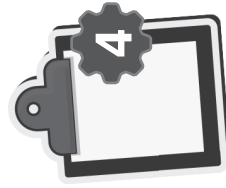
Design and Build

Sketch your terrace system. What purpose will each part serve? What materials will work best? Build the model.



Test and Improve

Pour 1 L (about 1 qt.) of water into the top of the system. Does the water flow in a controlled manner? Does your terrace system absorb all the water? Did it spill over once it reached the bottom layer? How can you improve it? Modify your design, and try again.



Reflect and Share

What other materials can you use to build the model? Can you add more layers to your design? How can you modify your design to make water move more quickly or more slowly through the system?

