

Making Research Relevant: 187° Fahrenheit!

Exploring Peru's Boiling River

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Grade Level High School
Duration 3-5 class periods

National Standards

GEOGRAPHY STANDARDS

Element 2: Places and Regions

4. The physical and human characteristics of places.

Element 4: Human Systems

14. How human actions modify the physical environment.

AZ Standards

ELA

Reading

Key Ideas and Details

9-10.RI.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Writing

Research to Build and Present Knowledge

9-10.W.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Speaking and Listening

Presentation of Knowledge and Ideas

9-10.SL.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task; use appropriate eye contact, adequate volume, and clear pronunciation.

SCIENCE

Earth and Space

Plus HS+E.E1U3.9 Construct an explanation, based on evidence, for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

TECHNOLOGY

Knowledge Constructor

9-12.3.b. Students evaluate the accuracy, perspective, credibility, and relevance of information, media, data or other resources.

Arizona Social Science Standards

Geography

Human-environment interactions are essential aspects of human life in all societies.

HS.G2.1 Analyze interactions within and between human and physical systems.

HS.G2.4 Evaluate the use and sustainability of natural resources.

Examining human population and movement helps individuals understand past, present, and future conditions on Earth's surface.

HS.G3.5 Evaluate the impact of social, political, and economic decisions that have caused conflict or promoted cooperation throughout time.

Global interconnections and spatial patterns are a necessary part of geographic reasoning.

HS.G4.1 Take an active stance on a geographic issue reflecting its scale (local, regional, state, national, or global)

SLOP Elements		
<p>Preparation Adapting content Linking to background Linking to past learning Strategies used</p>	<p>Scaffolding Modeling Guided practice Independent practice Comprehensible input</p>	<p>Grouping Option Whole class Small groups Partners Independent</p>
<p>Integrating Processes Reading Writing Speaking Listening</p>	<p>Application Hands on Meaningful Linked to objectives Promotes engagement</p>	<p>Assessment Individual Group Written Oral</p>

Arizona English Language Proficiency Standards

Stage IV

Basic

Listening, Speaking, Reading, and Writing

Standard 7: By the end of each language proficiency level, an English learner can: conduct research and evaluate and communicate findings to answer questions or solve problems.

B-1: gather information from multiple provided resources to answer questions.

B-2: summarize the main idea using evidence from text or presentations.

B-4: cite sources used in research appropriately.

Language

Standard 9: By the end of each language proficiency level, an English learner can: create clear and coherent grade-appropriate speech and text.

B-1: introduce and develop an informational topic, using an increasing range of transition and other linking words (e.g., before, because, also) when speaking and writing.

B-2: introduce and present facts, using an increasing range of transition and other linking words to connect, compare, and contrast information (e.g., before, because, also) when speaking and writing.

Overview

The Shanay-Timpishka, also known as La Bomba, is a tributary of the Amazon River, is called the "only boiling river in the world". It is 6.4 km (4.0 mi) long. This geothermal phenomenon has left experts around the world perplexed.

Purpose

In this lesson students will learn about the science and cultural significance of Peru's boiling river by engaging in relevant research and constructing a big book together as a class. Examples of California and Yellowstone's geothermal features will be investigated to bring relevance to the research the students are doing.

Key Vocabulary

geothermal gradient: the amount Earth's temperature increases with depth

shaman: a healer who functions as the link between the physical and spiritual world

hydrothermal system: the circulation of water and heat through permeable rocks in the layers of the Earth

extremophile: a microorganism that is able to survive in extreme conditions (temperature, acidity, radiation, etc.)

conservation: preventing the wasteful use or exploitation of a resource

Materials

- Introduction PowerPoint
- Projector, computer, internet access

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- Boiling River TED Talk Worksheet and Answer Key
 - The boiling river of the Amazon (15:41 min) https://www.ted.com/talks/andres_ruzo_the_boiling_river_of_the_amazon?language=en
 - Boiling River Research Guides and Articles
 1. Hydrothermal Systems of Yellowstone National Park
 2. Extremophiles
 3. The Shaman, Culture, and Legends
 4. Andrés Ruzo
 5. Hypotheses for how the River Works
 6. How Does Peru's Boiling River Work?
 7. Tourism
 8. Conservation
 - Answer Keys to Research Guides and Articles
 - Boiling River: Big Book Project Rubric
 - Boiling River Presentation Worksheet
 - Poster Paper
 - Markers
 - Packaging Tape
 - Boiling River Project Reflection Form
 - Big Book Tutorial and Examples
- b. Project slide 17. Have student think-pair-share with the following questions: (1) What do you know about boiling rivers? Have you ever heard about a boiling river? (2) How do you think boiling rivers work? (**Grouping Option: Partners**) Conduct a class discussion on what they talked about in the think-pair-share. (**Grouping Option: Whole Class**)
- c. Project slide 18. Inform students that we will be focusing on this river because it's a geothermal phenomenon. Continue class discussion by asking students to define the words "geothermal" and "phenomenon." (**Grouping Option: Whole Class**)
- d. Project slide 19. Distribute the Boiling River TED Talk Worksheet and play the YouTube video: The boiling river of the Amazon (15:41 min) https://www.ted.com/talks/andres_ruzo_the_boiling_river_of_the_amazon?language=en
- e. Close class with going over the correct answers and having students share responses to the last question on the worksheet. (**Scaffolding: Comprehensible Input**)

Objectives

The student will be able to:

1. Explain the cultural significance of the boiling river.
2. Explain how the boiling river works in accordance with Earth's geothermal gradient.
3. Conduct research
4. Create a class project.
5. Describe current conservation efforts and ways to help with conservation efforts in the future.

Procedures

SESSION ONE

Engage:

- a. Project slides 1-9 of the Introduction PowerPoint. Ask students to identify what they are looking at and where it is. (Old Faithful Geyser in Calistoga, CA) Ask students if they have ever been there. What was it like? Project slides 10-14 and read as a class the information about this geyser. Then project slides 15-16 of Boiling River Hot Springs in Yellowstone National Park, WY. Ask if students have ever visited that location and have them share their experience and knowledge about that location. (**Preparation: Linking to Background**)

SESSION TWO

Prior to this Session: If you are unfamiliar with big books as a teaching tool, a tutorial is provided with this lesson.

Explore:

- a. Introduce the concept of big books to students. Explain that as a class they will be researching Peru's boiling river. Each page will focus on a different topic but a refrain will be present on each page of research. The refrain will be: "Peru's Boiling River is a geothermal phenomenon that is culturally and scientifically significant."
- b. Explain the structure of the provided research guides and the articles by using one guide as an example.
- c. Explain the Boiling River: Big Book Project Rubric discussing the required project elements (research and a presentation) and how they will be assessed. Allow time for student questions.
- d. Project the vocabulary words and show where in research guides the vocabulary words will be present. Emphasize to students that they will need to incorporate these words and definitions in their research guides, big book page, and in their presentations.
- e. Divide students into groups of 4. Have students decide which color they will use to complete their section of the research guide. (**Grouping Option: Small Groups**)
- f. Assign each group their topic and distribute the appropriate research guides and articles to the groups.

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- g. Provide the rest of the class period to work as a team on completing the research guide. **(Integrating Processes: Reading, Writing, Speaking; Application: Hands On)**

SESSION THREE

Explain:

- a. Provide time for students to complete research guides, make big book pages, and plan/practice their presentations. **(Integrating Processes: Reading, Writing, Speaking; Grouping Option: Small Groups, Application: Hands On)**

SESSION FOUR and FIVE

- a. Instruct students to get in groups and make sure they're prepared to present. **(Grouping Option: Small Groups)**
- b. Distribute the Boiling River Presentation Worksheet. Explain that as each group is presenting, they should be filling in the sheet.
- c. Conduct presentations in topic order – the goal is for each group to read their page of the book to the class (presented like you're reading the big book) **(Integrating Processes: Listening, Speaking)**

Elaborate:

- d. After the last group (Conservation) presents, start a small group discussion with the following questions: How does conservation connect to our everyday lives? What kinds of resources are being exploited in our community? What can we do to help conservation efforts? **(Grouping Option: Small Groups)**
- e. Have each group write a paragraph to connect conservation to their everyday lives. Ask a representative from each group to read their paragraphs out loud. Make a class list of ways we can help conservation efforts in our community. **(Application: Meaningful; Grouping Options: Whole Class)**
- f.

Evaluate:

- g. Assemble class big book using packaging tape to bind edges together. Attach conservation paragraphs to back side of each page (if room) or at the back of the big book. **(Application: Hands On, Promotes Engagement)**
- h. Distribute Boiling River Project Reflection to gather student reflections and feedback.
- i. Have students take vocabulary quiz. Discuss vocabulary quiz responses.

Assessment

Geography, Science and ELA

The Boiling River TED Talk Worksheet can be scored for completeness and accuracy. Mastery will be considered a score of 80% or higher.

The Boiling River Presentation Worksheet can be graded for completeness. Mastery will be considered a score of 90% or higher.

The Boiling River Project Reflection can be scored for completeness. Questions 8 and 9 should be scored for quality of the answers. Mastery will be considered high quality answers on questions 8 and 9.

The Vocabulary Test can measure language acquisition. Mastery will be considered a score of 80% or higher.

Geography, Science, Technology, and ELA

The big book and presentation can be scored with the Boiling River Big Book Project Rubric. Mastery will be considered a score of 80% or higher.

The Boiling River Research Guides can be scored for completeness and accuracy using the answer keys. Assign points as needed since the guides have different questions. Mastery will be considered a score of 80% or higher.

Extensions

- Students can conduct more research on the traditional culture and lives of the people who live near the river and what role the river plays in their lives.
- Students can conduct more research on other boiling rivers and how they work.
- Students can map of boiling rivers around the world,

Sources

Boiling River TED Talk

https://www.ted.com/talks/andres_ruzo_the_boiling_river_of_the_amazon?language=en

The Search for Peru's Boiling River

<https://www.sciencefriday.com/articles/the-search-for-perus-boiling-river/>

The River That Kills Everything That Falls Into It

<https://www.nationalgeographic.com/adventure/article/160313-boiling-river-amazon-geothermal-science-conservation-ngbooktalk>

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A Legendary Boiling River that Flows into the Amazon: Can it be Saved?

<https://www.nationalgeographic.com/adventure/article/this-mythical-river-in-peru-is-boiling-and-one-young-scientist-is-on-a-quest-to-protect-it>

Big Book Examples (Stop 2 Learning Presentation)

<https://www.teachstemss.com/copy-of-module-2>