**Grades 3-5 Version (created by Becky Schnekser)**

**TEACHER NOTES (pages 1-8) STUDENT PAGES (pages 9-15)**
**Optional extension activities (pages 16+)**

**Teacher Background Knowledge:** (this is also included as nonfiction text with comprehension questions for students, pages 16-21)

## What Is the Boiling River?

The **Boiling River** (*Shanay-Timpishka*) is a real river located deep in the Peruvian Amazon that gets hot enough to boil—reaching temperatures up to **200°F (93°C)**. What makes this river so unusual is that it is **not near any active volcanoes**, which is where boiling water sources are typically found. Instead, the water is heated by geothermal energy from deep within the Earth, independent of volcanic activity.

The river is sacred to local Indigenous communities and has long been part of their cultural stories and practices. It gained global attention when **geoscientist Andrés Ruzo** began studying it scientifically and working with locals to understand and protect these unique natural features and the surrounding ecosystem. Each year, Andrés brings scientists from all disciplines to study the area to better understand the ecosystem, what lives here, and what doesn't. They also compare the ecology to other parts of the Amazon to better understand how this area is similar and different to other regions.

The Boiling River is an incredible example of how science, geography, culture, and conservation come together—and it's a powerful reminder that there are still natural mysteries to explore on our planet.

Projeto Mantis, a team of Brazilian Entomologists working with the Boiling River Team, seek to study and understand insects of all types, but specifically the praying mantis. Their field practices are different from most while they capture live specimen, keep until natural death, studying their behaviors, and once they die of a natural death, then prepare typical box pinning as you would see in museum displays. Oftentimes, scientists collect specimen in the field and immediately immerse in formaldehyde or isopropyl alcohol to bring back to their laboratories to study. Using the techniques by Projeto Mantis requires special containers for collecting and maintaining specimen. Containers must allow the creature inside space to thrive, breathe, and live a comfortable life that mimics their natural environment but also be portable, collapsible, and sturdy for handling in the field. It is also important that the container be lightweight to keep costs of transport as low as possible.

The Projeto Mantis team needs YOUR help. Design, create, and test a 3-dimensional container to carry specimens collected in the field to the laboratory.

This lesson plan allows students to connect to how a team of scientists seeks to answer these questions: What insects live in the Boiling River area? How is this similar to and different from other parts of the Amazon?

### Boiling River Entomology Design Challenge Brief:

Projeto Mantis, a team of Brazilian Entomologists working with the Boiling River Team, seeks to study and understand insects of all types, but specifically the praying mantis. Their field practices are different from most while they capture live specimens, keep them until natural death, study their behaviors, and once they die of a natural death, then prepare typical box pinning as you would see in museum displays. Oftentimes, scientists collect specimens in the field and immediately immerse them in formaldehyde or isopropyl alcohol to bring them back to their laboratories to study. Using the techniques by Projeto Mantis requires special containers for collecting and maintaining specimens. Containers must allow the creature inside space to thrive, breathe, and live a comfortable life that mimics their natural environment, but also be portable, collapsible, and sturdy for handling in the field. It is also important that the container be lightweight to keep the costs of transport as low as possible. Don't forget, these scientists must carry all of their equipment while out collecting specimen.

The Projeto Mantis team needs YOUR help. Design, create, and test a 3-dimensional container to carry specimens collected in the field to the laboratory.

**Teacher Notes:** This project leads students through a 6 phase project. That sounds like a lot, but it is intentionally broken down this way to help support students completion and success with the project.

Phase 1: Students plan their project in this phase beginning with the selection of what insect they will create a container for. Students do not have to design their container for praying mantises–rather, an insect of their choice. In phase 1 of the activity, they will need to choose the specimen for which they are designing, which will inform the size of the container they design and build. There is also a place for students to record the resources they used to determine the size of the container needed–ideally, students will research their chosen insect to determine this information and then record the source(s). This is great practice for simple research and source citing. This phase also includes time for students to brainstorm how they will test their creation to ensure it meets project criteria, sketch their design, and list materials they would like to use. As the teacher, you can decide how to handle materials–do you have set materials for each team? Can they bring things from home? Will they have to budget and "pay" for certain materials (this is great way to integrate more math practice)?

Phase 2: In this phase, students are creating their prototypes. It is a good idea to provide a time limit for this phase while it tends to be when groups use a vastly different amount of time to be productive.

Phase 3: Phase three is all about testing the prototypes. After creating them, teams should make sure that it passes all the criteria for the project.

Phase 4: This phase allows students to modify their projects to better meet the criteria. This is another phase that benefits from time parameters to keep students motivated and engaged in the project. They should also record any modifications they make in the recording sheets.

Phase 5: Phase five requires students to devise a communication plan to "pitch" their project idea to the team of entomologists. Essentially, they want their design "chosen." This can be facilitated in many different ways depending on your capacity and time limits. Students can present to you, to the class, or even to invited guests to your classroom. You can also determine whether a "winner" is selected or whether this is just a great way to practice public speaking and persuasive writing.

Phase 6: This phase is for reflection. Students are given several reflection questions to think about the project process and how their team faced challenges throughout.

**Learning Standards:**

| **Next Generation Science Standards (NGSS)** |
|---|
| 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost |
| 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. |
| 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved |

| **Sustainable Development Goals:** |
|---|
| 15- Life on Land: Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. |

| **Common Core** | |
|---|---|
| 3.MD.4 | Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot where the horizontal scale is marked off in appropriate units— whole numbers halves or quarters. |
| 3.MD.5 | Recognize area as an attribute of plane figures and understand concepts of area measurement. |
| 3.MD.7b | Multiply side lengths to find areas of rectangles with whole number side lengths in the context of solving real world and mathematical problems and represent whole-number products as rectangular areas in mathematical reasoning. |
| 3.MD.8 | Solve real world and mathematical problems involving perimeters of polygons including finding the perimeter given the side lengths finding an unknown side length and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. |
| 4.MD.1 | Know relative sizes of measurement units within one system of units including km m cm; kg g; lb oz.; l ml; hr min sec. Within a single system of measurement express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two- column table. |

| | |
|---|---|
| 4.MD.3 | Apply the area and perimeter formulas for rectangles in real world and mathematical problems. |
| 5.MD.3 | Recognize volume as an attribute of solid figures and understand concepts of volume measurement. |
| 5.MD.5 | Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. |
| 5.MD.5b | Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole number edge lengths in the context of solving real world and mathematical problems. |

**Advanced Preparation:**

- Collect materials for students to build models and have them readily available
- Decide whether you would like students to work alone or with a collaborative team
- Decide on protocols for students or teams to record progress along the way
  - o For example, will they keep a journal or sketchbook daily?
- Consider preparing students to identify insects, best practices to locate them, and connect specifically to praying mantises
- Consider introducing students to the Projecto Mantis Team that worked at the Boiling River
  - Website of the Boiling River Expedition
    - Extension activity about the team on page 22
  - Team Bios
    - This is the main team that consists of two scientists

**Materials:**

- Items for prototype construction
- Journal or way to track progress along the way
- Student recording sheets

**Specimen container requirements:**

- able to lie flat when not in use
- lightweight
- allow for the specimen to move around comfortably within the container
- rigid to withstand movement in the field and storage between the field and the lab

**Potential Grading Rubrics**

Written Response Rubric (numerical, developmental scale 1, developmental scale 2)

- Can be used to evaluate written pieces such as reflection phase

Project Rubric

- Can be used to assess the project completion

Student Name: ________________________________________

Written Response Rubric

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Response may or may not answer all questions OR contain a large amount of grammatical errors | Response may or may not answer all questions OR contain several grammatical errors | Responses answer all questions, but might have minor grammatic errors | Responses answer all questions, use complete sentences, and show thinking about learning. |

| Comments: |
|---|
| |

Student Name: ______________________________________

Written Response Rubric

| insightful | thorough | basic | marginal | inadequate |
|---|---|---|---|---|
| The response shows deep thought, reflection, and connection to learning with elaboration | The response shows thought, reflection, and connection to learning with elaboration. | The response answers the questions but does not elaborate or show deep reflection or connection to learning | The response shows minimal thought, reflection, or connection to learning | The response does not show thoughtful reflection or connection to learning |

| Comments: |
|---|

Student Name: ___________________________________

## Written Response Rubric

| **emerging** | **developing** | **proficient** |
| --- | --- | --- |
| Response does not answer all questions, contains many grammatical errors or inconsistencies | Response might not answer all questions, contain grammatical errors or inconsistencies | Response answers all questions in complete sentences, free from grammatical error |

| Comments: |
| --- |
| |

# Entomology Project Rubric

| | 0 | 1 | 2 | Comments |
|---|---|---|---|---|
| **Able to lay flat when not in use** | Creation is unable to lie flat | Creation can be made smaller, but does not completely flatten | Creation is able to completely flatten/ | |
| **lightweight** | Creation has a noticeable weight to it. It might be a pound or heavier. | Creation has noticeable weight but does not approach 1 pound. | The creation is lightweight, and barely noticeable in terms of weight. Might not register on a scale. | |
| **allow for the specimen to move around comfortably within the container** | Specimen would not have space to move around comfortably. It might not even fit in the container. | Specimen fits in container, but would not have ample space to move. | Container has adequate space for the specimen to be inside and move around freely. | |
| **rigid to withstand movement in the field and storage in between the field and lab** | Construction does not appear strong enough to withstand rigidity test<br><br>OR<br><br>Project fails to withstand rigidity test | Construction seems to be able to withstand some movement or storage but may contain questionable wobble or strength integrity<br><br>OR<br><br>Project partially withstands rigidity test, may contain minor damage | Construction seems sturdy enough to withstand rigidity test.<br><br>OR<br><br>Project successfully withstands rigidity test. | |
| **Project Documentation** | Documentation is missing altogether or contains very little project progress | Documentation is present although some details of the project may be missing | Documentation thoroughly shows the progression of project | |
| **Communication** | Engineer or team of engineers does not explain project or many or major details are unclear | Engineer or team of engineers is able to explain project and answer questions, some details may be unclear | Engineer or team of engineers is able to thoroughly explain project and answer questions | |

# Points earned ________ / 14 points possible

**Name:** ___________________________________ **date:** __________________

**Entomology Design Challenge**

Projeto Mantis, a team of Brazilian Entomologists working with the Boiling River Team, seeks to study and understand insects of all types, but specifically the praying mantis. Their field practices are different from most while they capture live specimens, keep them until natural death, study their behaviors, and once they die of a natural death, then prepare typical box pinning as you would see in museum displays. Oftentimes, scientists collect specimens in the field and immediately immerse them in formaldehyde or isopropyl alcohol to bring them back to their laboratories to study. Using the techniques of Projeto Mantis requires special containers for collecting and maintaining specimens. Containers must allow the creature inside space to thrive, breathe, and live a comfortable life that mimics their natural environment, but also be portable, collapsible, and sturdy for handling in the field. It is also important that the container be lightweight to keep the costs of transport as low as possible. Don't forget, these scientists must carry all of their equipment while out collecting specimens.

The Projeto Mantis team needs YOUR help. Design, create, and test a 3-dimensional container to carry specimens collected in the field to the laboratory.

**Specimen container requirements:**

- able to lie flat when not in use
- lightweight
- allow for the specimen to move around comfortably within the container
- rigid to withstand movement in the field and storage between the field and the lab

**Part 1: Planning Phase**

| **Specimen Type (what will be collected?):** |
|---|
| |

| **How much space will your specimen need?** |
|---|
| |

| **What resources did you use to find this answer?** |
|---|
| |

| How will you test your model? |
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| List the Materials you will need to create your model | |
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| **Sketch the design of your model here. Be sure to draw and label each part.** |
| --- |
| |

**Part 2: Create**

**Build your model based on your design. If you have to modify your design while building, you must record changes here.**

| |
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| |

**Part 3: Test**

**You must now test your model to ensure it meets the requirements. Record below the steps for testing, protocols, as well as the results.**

| **Testing Protocols** |
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| |

| **Results (what happened during testing?)** |
| --- |
| |

**Step 4: Modify**

| Based on your test and results, what changes will you make? How can you improve your model? Make a plan, record below, and get started! |
| --- |
| |

**Step 5: Communicate**

| How will you communicate your project to the team of entomologists? |
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| |

**Let's get started! Begin and complete your communication piece!**

**Step 6: Reflection**

| What parts of this challenge were difficult for you? How did you overcome the difficult parts? |
|---|
| |
| **What parts of this challenge were easy for you? What made them easy for you?** |
| |
| **In what ways did you use observation during this project? How did using this skill help you complete the project?** |
| |

| **In what ways did you use collaboration during this project? How did using this skill help you complete the project?** |
| --- |
| |
| **In what ways did you use communication during this project? How did using this skill help you complete the project?** |
| |
| **If you could change one thing about this project, what would you change and why?** |
| |

# The Boiling River & Projeto Mantis

The **Boiling River** (*Shanay-Timpishka*) is a real river located deep in the Peruvian Amazon that gets hot enough to boil—reaching temperatures up to **200°F (93°C)**. What makes this river so unusual is that it is **not near any active volcanoes**, which is where boiling water sources are typically found. Instead, the water is heated by geothermal energy from deep within the Earth, independent of volcanic activity.

The river is sacred to local Indigenous communities and has long been part of their cultural stories and practices. It gained global attention when **geoscientist Andrés Ruzo** began studying it scientifically and working with locals to understand and protect these unique natural features and the surrounding ecosystem. Each year, Andrés brings scientists from all disciplines to study the area to better understand the ecosystem, what lives here, and what doesn't. They also compare the ecology to other parts of the Amazon to better understand how this area is similar and different to other regions.

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## Comprehension Questions – The Boiling River & Projeto Mantis

### Recall & Detail

1. Where is the Boiling River located?
2. How hot can the Boiling River get?
3. What is unusual about the Boiling River compared to other boiling water sources?
4. Who is the geoscientist who studies the Boiling River?
5. What does Projeto Mantis mainly study?

### Vocabulary in Context

6. What does *geothermal energy* mean in the text?
7. What does it mean when the text says the Boiling River is “sacred” to local Indigenous communities?
8. In the context of the text, what is meant by “specimens”?

### Understanding Concepts

9. Why is the Boiling River important to both science and culture?
10. How does Projeto Mantis’s method of collecting insects differ from more common methods?

### Critical Thinking

11. Why do you think scientists want the containers for insects to be lightweight, portable, and collapsible?
12. What might scientists learn by comparing the Boiling River ecosystem to other parts of the Amazon?
13. How do you think cultural traditions can help protect natural places like the Boiling River?

# Multiple Choice – The Boiling River & Projeto Mantis

**1. Where is the Boiling River located?**
A. In the Brazilian Amazon
B. In the Peruvian Amazon
C. In the Andes Mountains
D. Near an active volcano

**2. What is unusual about the Boiling River?**
A. It freezes in winter
B. It has colorful minerals
C. It is not near any active volcanoes
D. It flows underground

**3. Who is the geoscientist that studies the Boiling River?**
A. Jane Goodall
B. Andrés Ruzo
C. Neil deGrasse Tyson
D. Sylvia Earle

**4. What does Projeto Mantis mainly study?**
A. River fish
B. Praying mantises
C. Amphibians
D. Water quality

**5. What does "geothermal energy" mean?**
A. Heat from the Sun
B. Heat from deep within the Earth
C. Energy from ocean waves
D. Energy from burning plants

**6. What does it mean that the Boiling River is "sacred" to local Indigenous communities?**
A. It is dangerous to swim in
B. It is important in their culture
C. It is used for fishing
D. It has a lot of minerals

**7. In the text, what are “specimens”?**
A. Tools for measuring temperature
B. Samples or examples of animals, plants, or other things studied by scientists
C. Parts of the river
D. Drawings in a field notebook

**8. Why is the Boiling River important to both science and culture?**
A. It produces electricity and provides drinking water
B. It is both a natural wonder and part of Indigenous traditions
C. It is a major tourist destination
D. It contains valuable minerals

**9. How does Projeto Mantis’s collection method differ from most?**
A. They release insects immediately after catching them
B. They keep insects alive until they die naturally before preserving them
C. They only collect dead insects from the ground
D. They only photograph insects and never collect them

**10. Why do scientists want insect containers to be lightweight, portable, and collapsible?**

A. To keep insects cool
B. To reduce cost and make them easier to carry in the field
C. To prevent insects from escaping
D. To make the containers look nicer

**11. What might scientists learn by comparing the Boiling River ecosystem to other parts of the Amazon?**
A. How to make the river hotter
B. How ecosystems are similar and different
C. How to build volcanoes
D. How to stop rivers from boiling

**12. How can cultural traditions help protect natural places like the Boiling River?**
A. By attracting tourists
B. By creating laws
C. By fostering respect and care for the area
D. By cooling down the river

# KEY Multiple Choice – The Boiling River & Projeto Mantis

**1. Where is the Boiling River located?**
A. In the Brazilian Amazon
B. In the Peruvian Amazon ✅
C. In the Andes Mountains
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**2. What is unusual about the Boiling River?**
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B. It has colorful minerals
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D. It flows underground

**3. Who is the geoscientist who studies the Boiling River?**
A. Jane Goodall
B. Andrés Ruzo ✅
C. Neil deGrasse Tyson
D. Sylvia Earle

**4. What does Projeto Mantis mainly study?**
A. River fish
B. Praying mantises ✅
C. Amphibians
D. Water quality

**5. What does "geothermal energy" mean?**
A. Heat from the Sun
B. Heat from deep within the Earth ✅
C. Energy from ocean waves
D. Energy from burning plants

**6. What does it mean that the Boiling River is "sacred" to local Indigenous communities?**
A. It is dangerous to swim in
B. It is holy or very important in their culture ✅
C. It is used for fishing
D. It has a lot of minerals

**7. In the text, what are “specimens”?**
A. Tools for measuring temperature
B. Samples or examples of animals, plants, or other things studied by scientists ✅
C. Parts of the river
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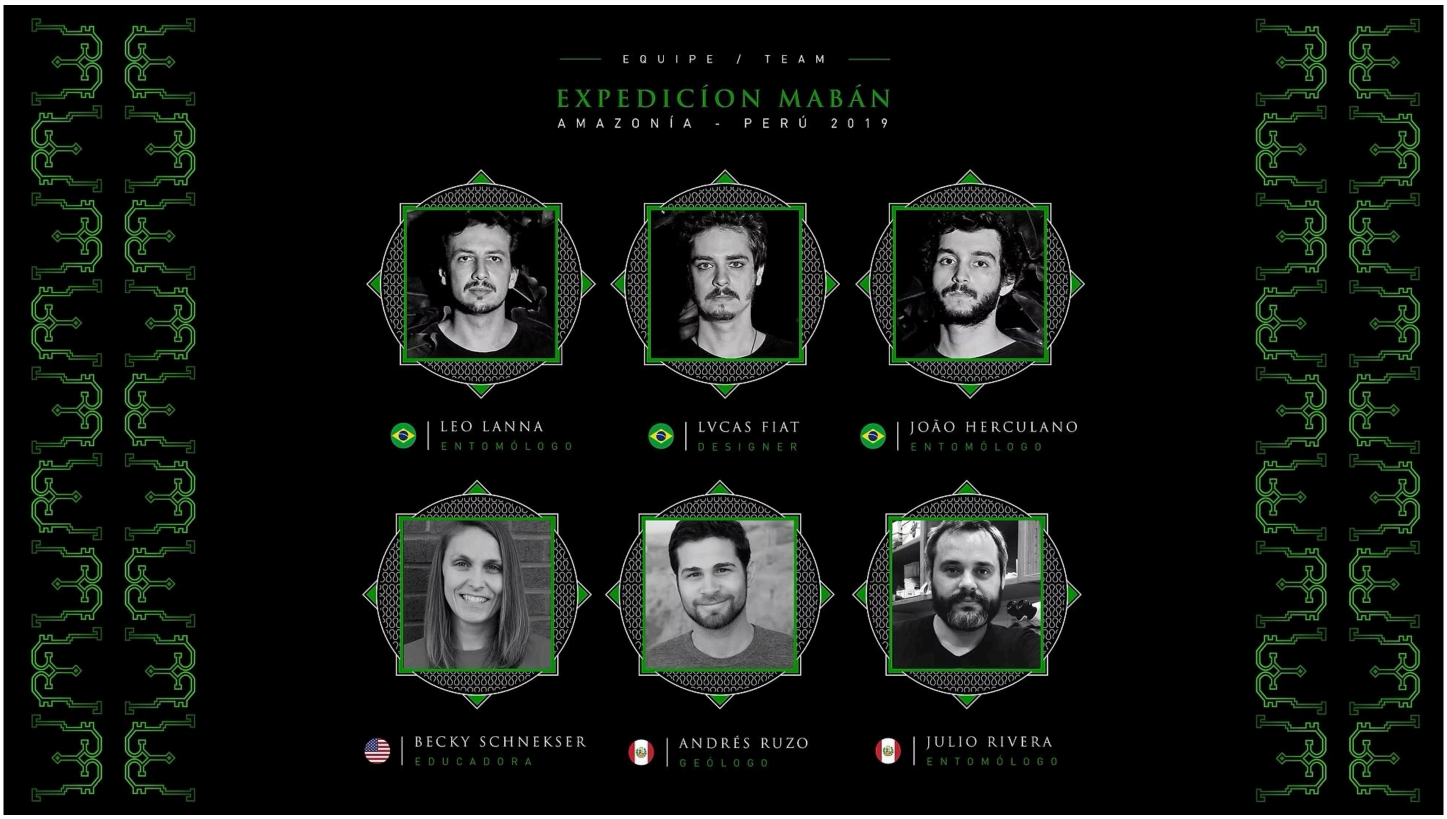
B. By creating laws
C. By fostering respect and care for the area ✅
D. By cooling down the river

# What’s in a Team?

Teams and teammates matter whether you are playing a sport, board game, or heading out on a scientific expedition. In 2019, the team pictured below was created to complete a scientific expedition in the Peruvian Amazon about insects, and more specifically, praying mantises. Take a few moments to observe the team photo. What do you notice about this team?




| **Observations about the Expedition Maban Team** |
| --- |
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Now that you have made observations, what has sparked your curiosity? What questions do you have about this team?

| Questions about the Expedition Maban Team |
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If you were building a team to go on a scientific expedition about insects, who would you want on your team? Why would you invite them?

| Team Member | Justification (why) |
|---|---|
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| | |

With your small group, share about your teammate choices. Based on what others have shared, would you change any of your choices? Why or why not?

| |
|---|
| |