Boiling River STEM Challenge Specimen Container Grades K-2

created by Becky Schnekser

STEM Challenge
Specimen Container
grades K-2

Thank you for using this resource. It was created based on my expeditions to the Boiling River which began in 2018.

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TEACHER NOTES (pages 1-7)

STUDENT PAGES (pages 8-12)

Optional extension activities (pages 13+)

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STEM Challenge: Specimen Container

Teacher Background Knowledge:

(this is also included as nonfiction text with comprehension questions for students, pages 13-14)

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?

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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. Introducing students to a praying mantis and the measurement (size) of the container you are building. This is a good time to introduce a ruler, the number 5, and identify 5 inches as a length for the project.

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 amounts of time to be productive.

Phase 3: Phase three is all about testing the prototypes. After creating them, it is time to test that they meet the project requirements. This is a great time to practice measuring!

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 present their creations. This is a great time to practice show and tell with their projects.

Phase 6: This phase is for reflection. This is a great time to talk as a whole group about challenges during the project!

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Next Generation Science Standards (NGSS)

K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool
K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem
K-2-ETS1-3: Analyze data from tests of two objects designed to solve the same problem to compare strengths and weaknesses of how each performs

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

K.CC.A.3 Write numbers from 0 to 20. Represent a number of objects with a written numeral 0-20 (with 0 representing a count of no objects).
K.CC.C.7 Compare two numbers between 1 and 10 presented as written numerals.
K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
K.G.B. 5 Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.
1.MD.A.2 Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps*.
1.G.A.2 Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.
2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2.MD.A.3 Estimate lengths using units of inches, feet, centimeters, and meters.

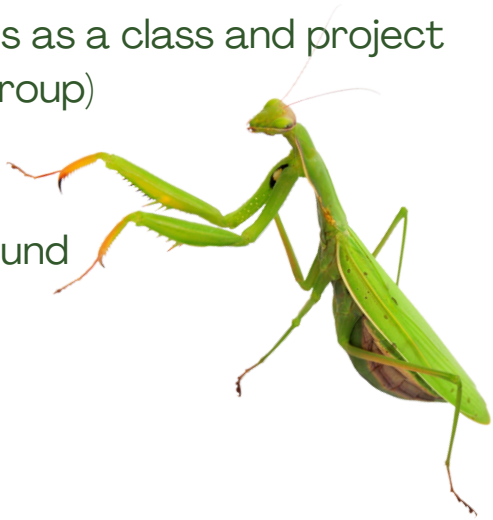
STEM Challenge: Specimen Container

Advanced Preparation:

- Collect materials for students to build models and have them readily available
- Decide whether you would like to complete this as a whole class, students to work alone or with a collaborative team—or a combination of this during the project
- Consider preparing students to identify praying mantises
- Consider introducing students to the projeto Mantis Team that worked at the Boiling River
    - Website of the Boiling River Expedition
        - Extension activity about the team on page 11
    - Team Bios
        - This is the main team that consists of two scientists

Materials:

- Items for prototype construction
- Student recording sheets (you might complete this as a class and project these on a board or poster to complete in a big group)



Specimen container requirements:

· allow for a praying mantis to fit inside and move around
· tough--it will be carried during a long hike

*__Possible Project rubric included on the next page.__

Extensions:

- Nonfiction text and comprehension questions (Pages 9-10)
- What's a team? Critical Thinking Whole Group Exercise (pages 11-13

Entomology Project Rubric

	0	1	2	Comments
Creation is at least 5 inches tall, long, and wide	Creation is unable to lie flat	Creation can be made smaller, but it does not completely flatten	Creation is able to completely flatten	
rigid to withstand movement in the field and storage between the field and the lab	Construction does not appear strong enough to withstand the rigidity test OR The project fails to withstand the rigidity test	Construction seems to be able to withstand some movement or storage, but may contain questionable wobble or strength integrity OR The project partially withstands the rigidity test, may contain minor damage	Construction seems sturdy enough to withstand a rigidity test. OR The project successfully withstood the rigidity test.	
Communication	An engineer or a team of engineers does not explain the project or many or major details are unclear	An engineer or team of engineers is able to explain the project and answer questions, some details may be unclear	An engineer or team of engineers is able to thoroughly explain the project and answer questions	

Points earned _____ / 6 points possible

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Challenge: Projeto Mantis, a team of Brazilian Entomologists working with the Boiling RiveThe Projeto Mantis team needs YOUR help. Design, create, and test a 3-dimensional container to carry praying mantises collected in the field to the laboratory.

Design:

- allow for a praying mantis to fit inside and move around
- tough--it will be carried during a long hike

Part 1: Planning Phase

Specimen Type (what will be collected?):
Praying mantis

How much space will your specimen need?
The container must be at least 5 inches in length, width, and height

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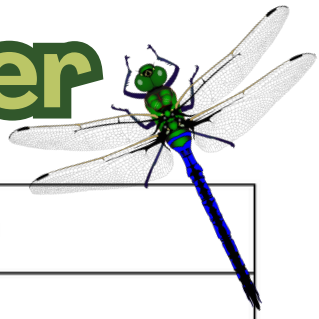

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List the Materials you will need to create your model	

Sketch the design of your model here.

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How will you test your model?

List the Materials you will need to create your model	

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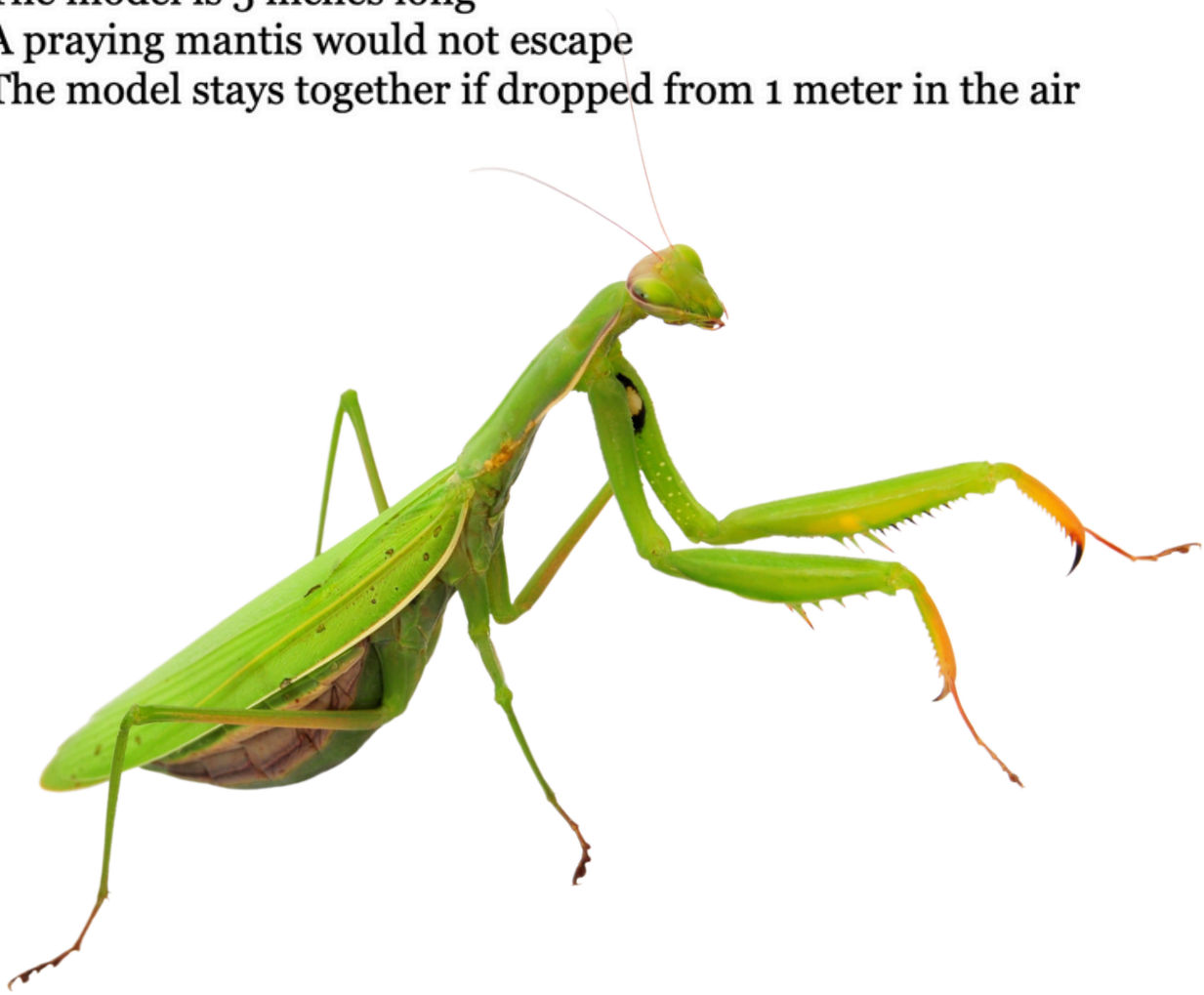
Part 2: Create

Build your model based on your design.

Part 3: Test

- ❑ The model is 5 inches tall
- ❑ The model is 5 inches wide
- ❑ The model is 5 inches long
- ❑ A praying mantis would not escape
- ❑ The model stays together if dropped from 1 meter in the air



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Step 4: Modify

If you need to change something about your model, this is the time to do it.

Step 5: Communicate

Show your model to the class.

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?

The Boiling River and projeto Mantis

The Boiling River is a real river in the Amazon rainforest in Peru. The water is very hot—so hot it can boil eggs! Most rivers like this are near volcanoes, but this one is not. The heat comes from deep underground.

The river is special to the local Indigenous people. They have told stories about it for a long time. A scientist named Andrés Ruzo studies the river with help from the local people. Many scientists visit to learn about the animals and plants that live here, and which ones cannot.

Projeto Mantis is a group of insect scientists from Brazil. They study praying mantises and other bugs. Instead of keeping bugs in jars with chemicals, they keep them alive until they die naturally. They make special boxes that keep the insects safe, comfortable, and able to breathe. These boxes are easy to carry, so the scientists can bring them into the rainforest.

Name: _____

Multiple Choice – The Boiling River & Projeto Mantis

Where is the Boiling River?
a) In a desert
b) In the Amazon rainforest
c) In the mountains

Why is the river unusual?
a) It has lots of fish
b) It is not near a volcano
c) It is very long

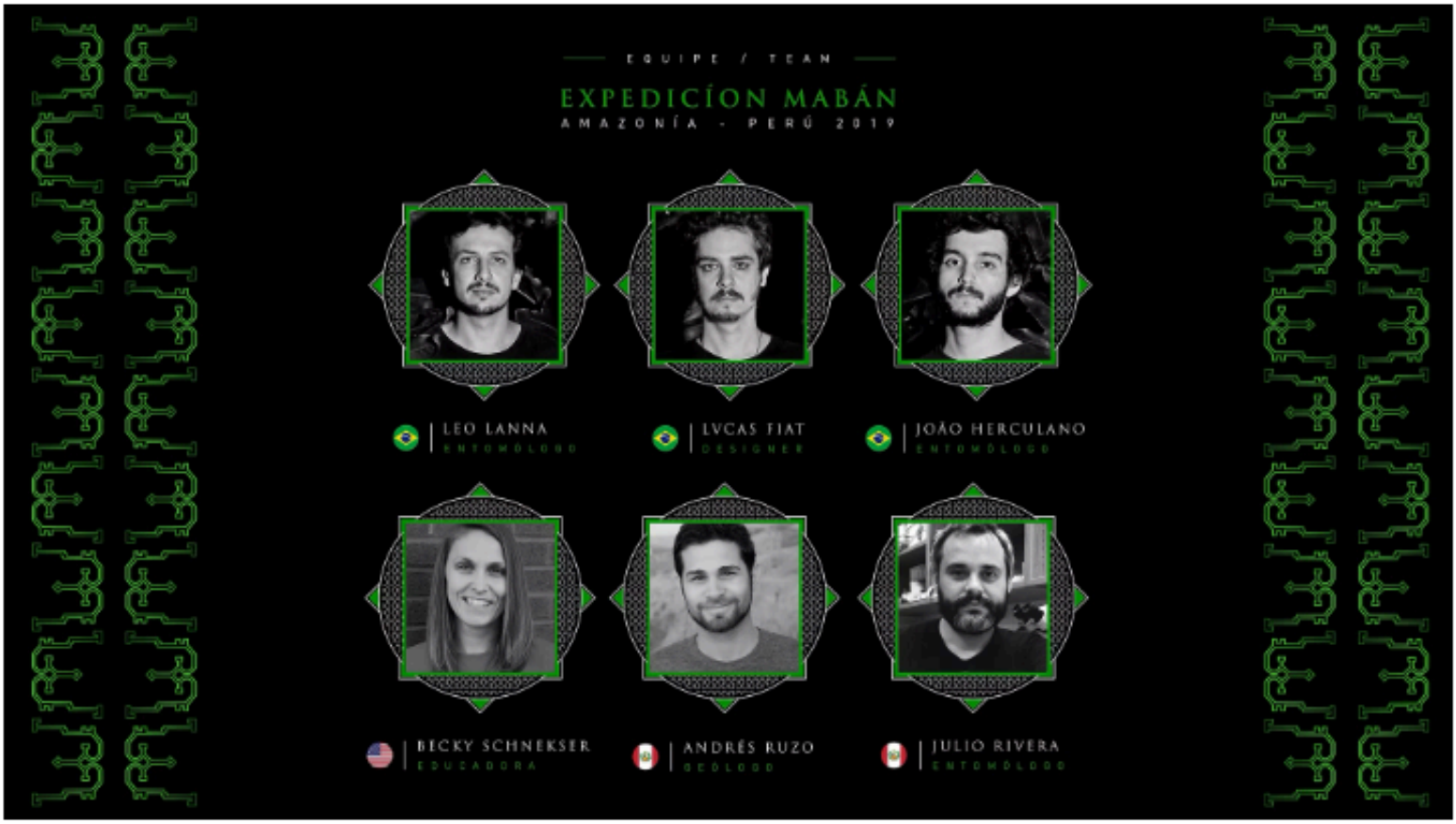
Who studies the river?
a) Andrés Ruzo and other scientists
b) Only visitors
c) Farmers

What do Projeto Mantis scientists study?
a) Birds
b) Insects
c) Trees

How do Projeto Mantis scientists treat insects?
a) They keep them alive until they die naturally.
b) They put them in water right away.
c) They let them go without studying them.

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

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

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)

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?
