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Smithsonian STEAM Readers—Grade 3

This sample includes the following:

Management Guide Cover (1 page)
Table of Contents (1 pages)
How to Use This Product (6 pages)
Lesson Plan (20 pages)
Reader (17 pages)

Smithsonian

STEAM Readers

Science • Technology • Engineering • Arts • Mathematics

Management Guide

Grade 3

Teacher Created Materials

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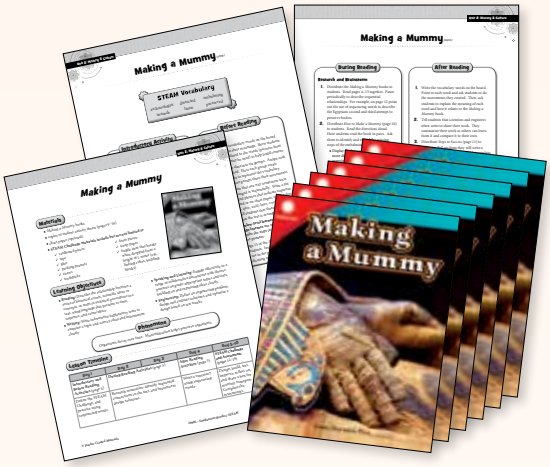
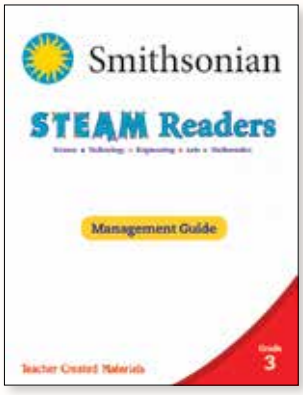
Kit Components

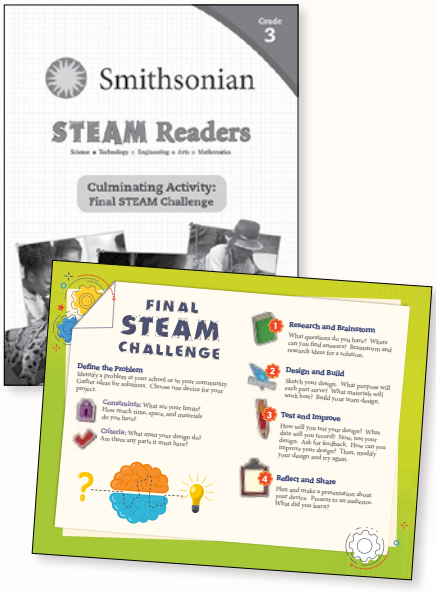
15 lesson plans with 6 copies of each book



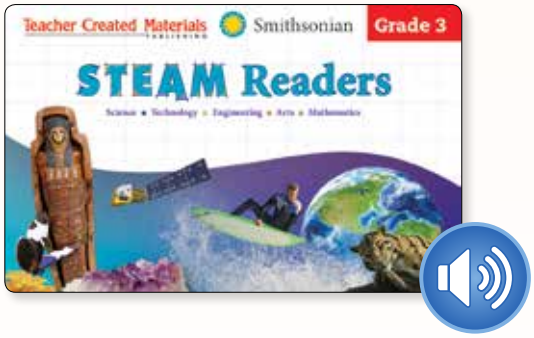
Management Guide



Culminating Activity



Digital and Audio Resources

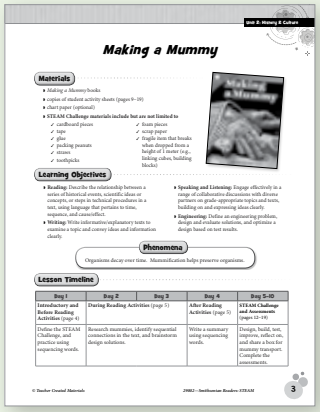


Lesson Plan Components

Each ten-day lesson sequence is organized in a consistent format for ease of use.

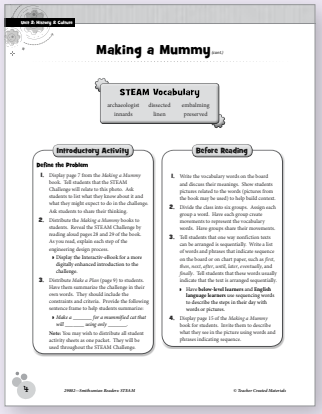
Overview

- The overview page includes learning objectives, a materials list, and a suggested timeline for lessons.



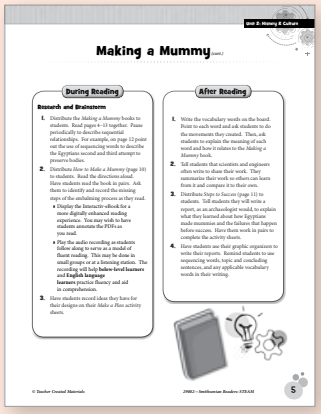
Day 1

- Students are introduced to the STEAM Challenge, vocabulary, and reading skill.



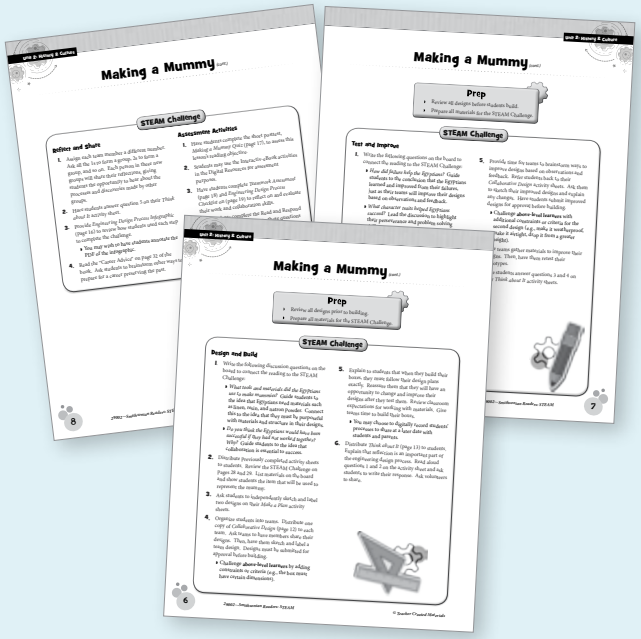
Days 2, 3, and 4

- Students complete reading and writing activities as they gain knowledge that will help them with the STEAM Challenge.



Days 5–10

- Students take what they've learned and apply it to design, build, test, and improve a solution.
- Students reflect, share work, and take assessments.



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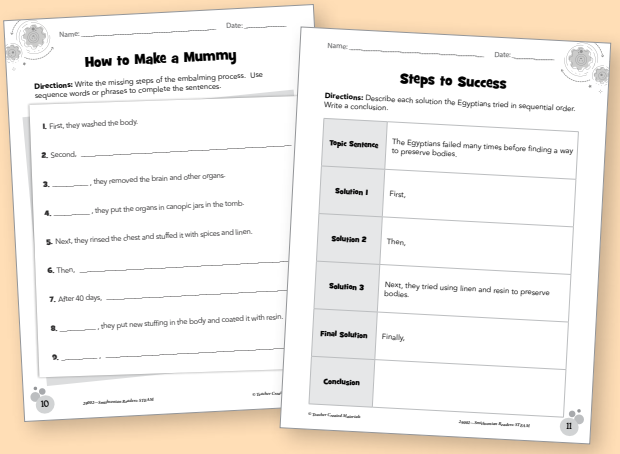
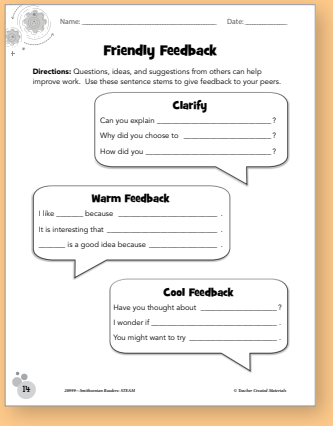
Lesson Plan Components *(cont.)*

Student Activity Sheets

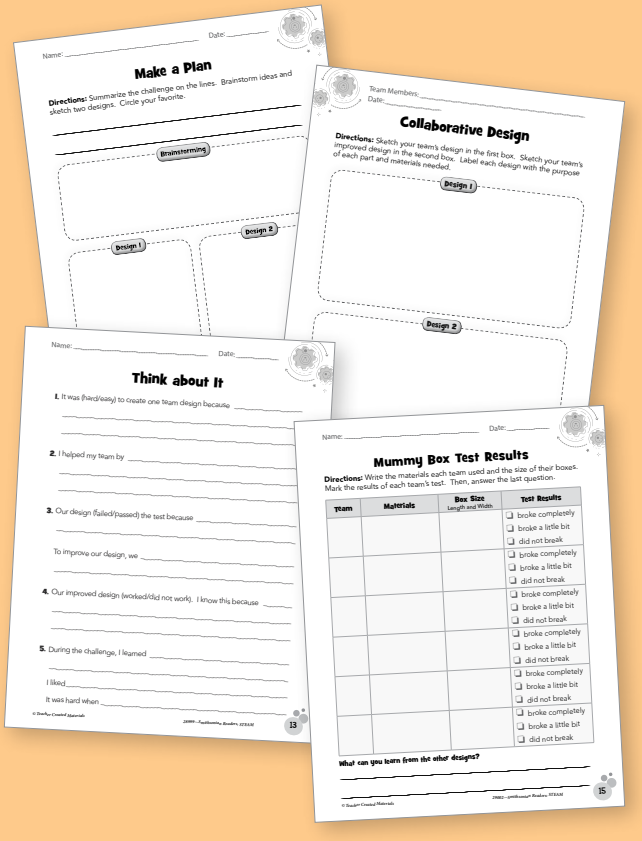
Literacy skills are supported with clear directions and activities that **promote higher-order thinking skills**.



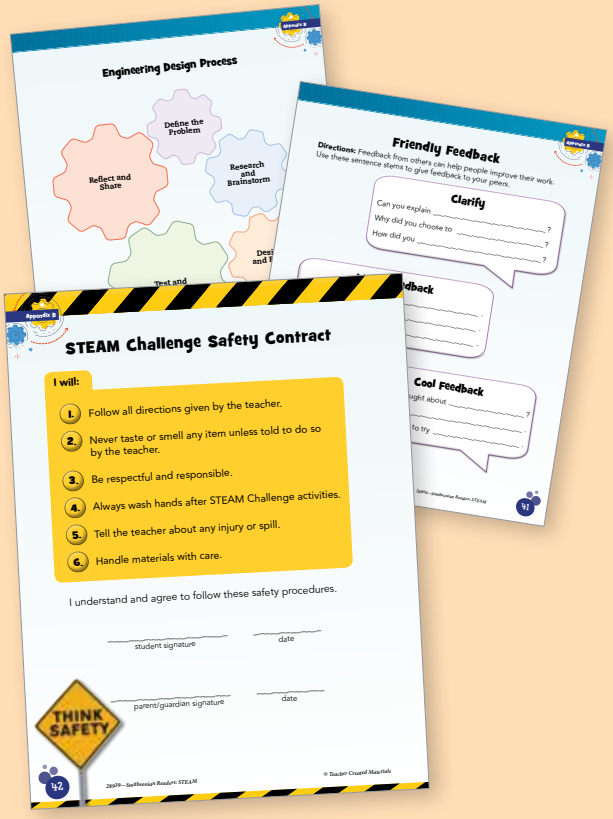
Effective feedback techniques are supported with **sentence frames** to help students provide feedback to peers and to facilitate productive classroom dialogue.



STEAM Challenge activity sheets support students throughout the **engineering design process**.



Appendix B includes quick reference sheets for students and teachers.



Assessments

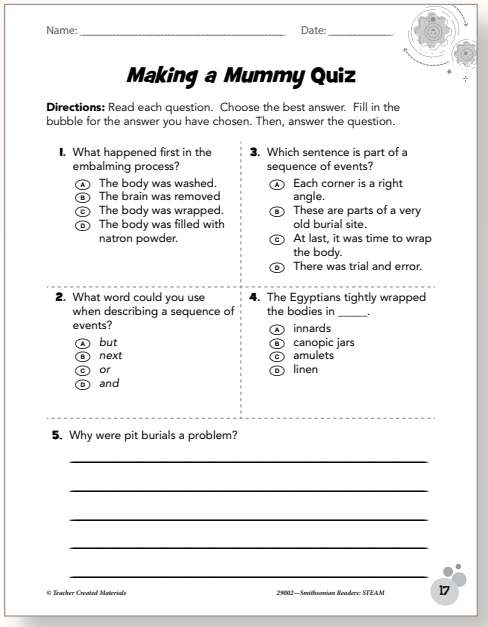
Assessment guides teacher decisions and improves student learning. *Smithsonian Readers: STEAM* offers balanced assessment opportunities. Assessments require students to demonstrate analytical thinking, comprehend informational texts, and write evidence-based responses.

Quizzes

Each lesson plan includes a quiz with multiple-choice questions and a short-answer question. These assessments include text-dependent questions and may be used as open-book evaluations. Answer keys are provided on page 2 of each lesson.

STEAM Challenge

STEAM Challenges include a *Teamwork Assessment* and an *Engineering Design Process Checklist*. These guide students to reflect on and evaluate their work and collaboration skills.



Name: _____ Date: _____

Making a Mummy Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen. Then, answer the question.

1. What happened first in the embalming process?
- (A) The body was washed.
- (B) The brain was removed
- (C) The body was wrapped.
- (D) The body was filled with natron powder.

2. What word could you use when describing a sequence of events?
- (A) *but*
- (B) *next*
- (C) *or*
- (D) *and*

3. Which sentence is part of a sequence of events?
- (A) Each corner is a right angle.
- (B) These are parts of a very old burial site.
- (C) At last, it was time to wrap the body.
- (D) There was trial and error.

4. The Egyptians tightly wrapped the bodies in _____.
- (A) innards
- (B) canopic jars
- (C) amulets
- (D) linen

5. Why were pit burials a problem?

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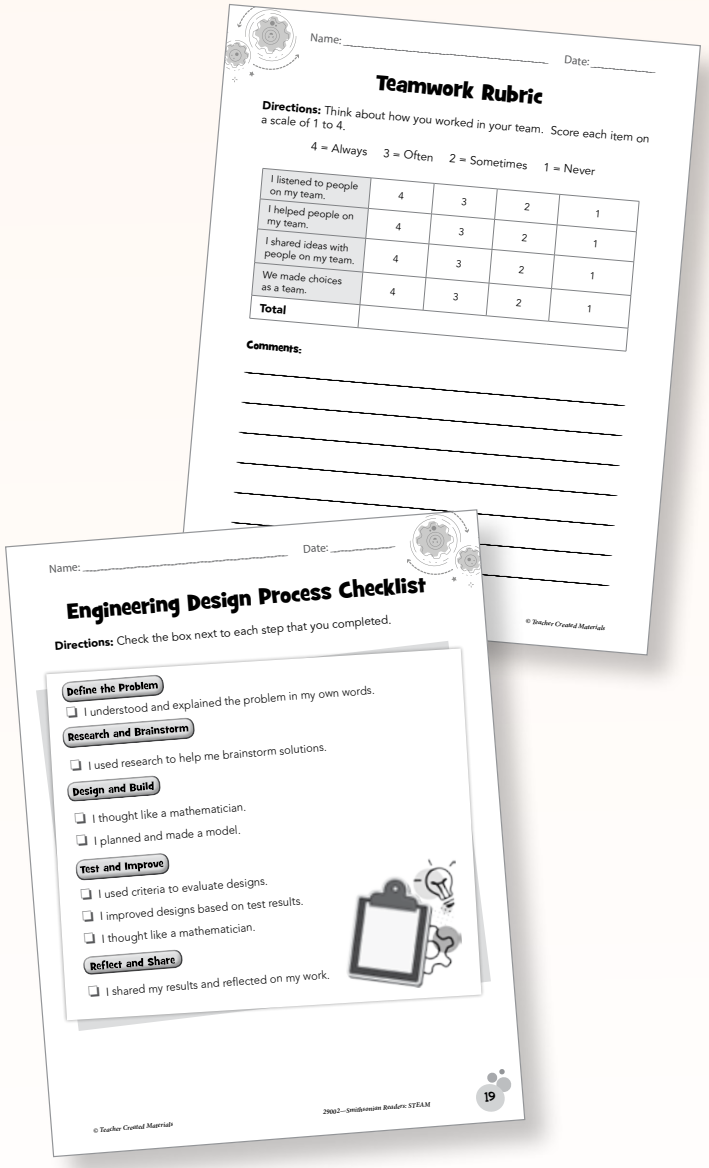

Name: _____ Date: _____

Teamwork Rubric

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

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				

Comments:

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Name: _____ Date: _____

Engineering Design Process Checklist

Directions: Check the box next to each step that you completed.

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

Test and Improve
- ❑ I used criteria to evaluate designs.
- ❑ I improved designs based on test results.
- ❑ I thought like a mathematician.

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

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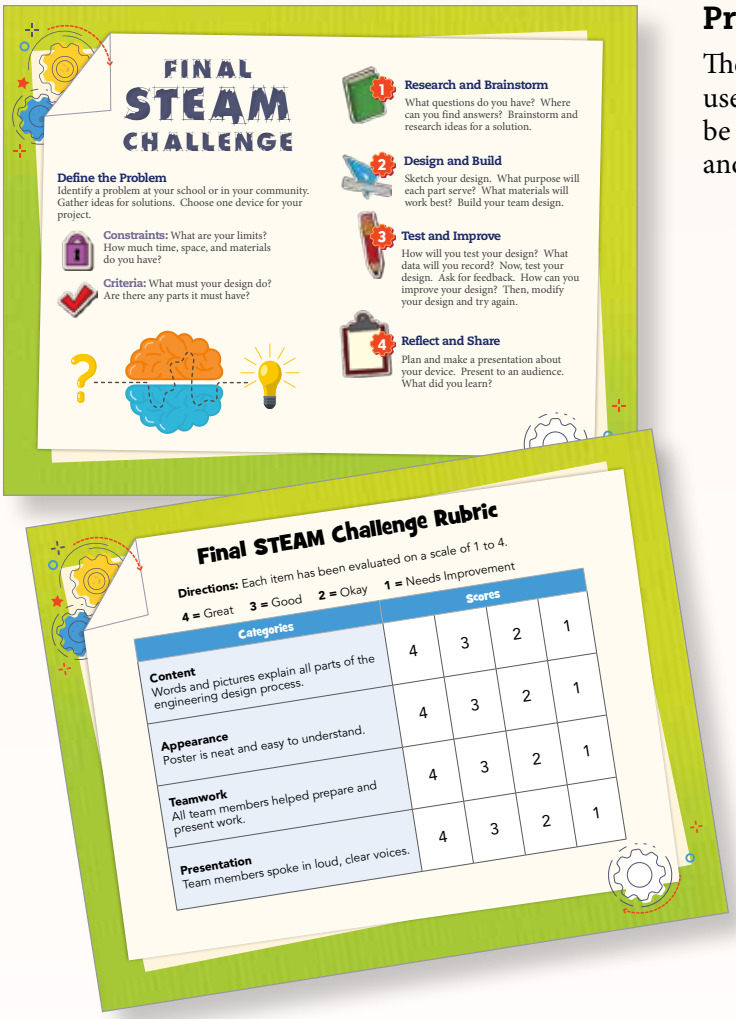
Assessments *(cont.)*

Culminating Activity

The Culminating Activity asks students to apply what they have learned in an engaging and interactive way. Students use what they have learned to solve real-world problems in a final STEAM Challenge.

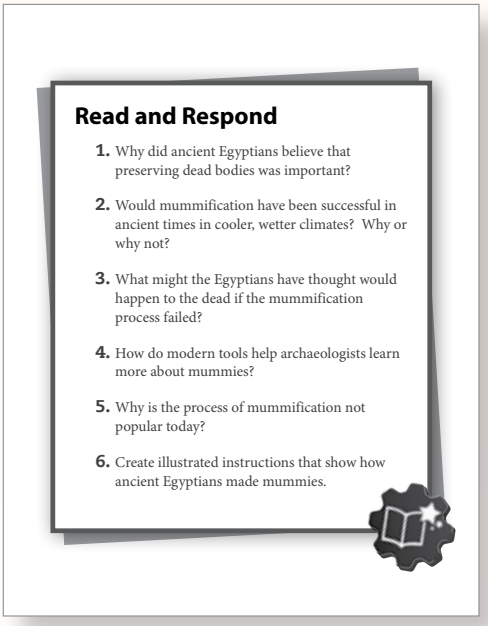


Read and Respond

Read and Respond questions can be found on the inside back covers of the books. Questions require various levels of critical thinking and can be used for instruction or assessment. Answer keys are provided in the digital resources.

Progress Monitoring

There are several points throughout each lesson when useful evaluations can be made. These evaluations can be based on group, paired, and individual discussions and activities.



Pacing and Instructional Setting Options

Smithsonian Readers: STEAM is flexibly designed and can be used in tandem with a core curriculum within a science block/STEAM/STEM block, and/or literacy block. It can also be used in makerspaces to integrate literacy with the engineering design process. Teachers should customize pacing according to student need and the teacher's preferred instructional framework, such as Balanced Literacy.

***Smithsonian Readers: STEAM* within the Balanced Literacy Framework**	
Modeled and Shared Reading/Writing	The Before, During, and After Reading activities in each lesson of this series offer opportunities for teachers to activate students' prior knowledge, as well as model fluency and metacognition as they read aloud from the text and guide students through reading and writing activities.
Small-Group Reading/ Workshop	The During Reading, After Reading, and STEAM Challenge activities in each lesson of this series can be completed during small-group instruction, in centers, or at workstations, depending on students' previous learning experiences and their need for teacher support.
Independent Reading	Professional audio recordings, PDFs of the books, and Interactiv-eBooks are provided to support independent reading at workstations and listening centers.
Assessment	This series offers multiple formative and summative assessment opportunities that can be used to guide instruction and assess learning (see pages 20–21 for details).

The following pacing and instructional setting options show suggestions for how to use this product. Two pacing options are provided.

Option 1 includes both literacy and STEAM Challenge activities. This option spans 10 instructional days and requires approximately 30–45 minutes a day, for a total of 75–112.5 hours over the course of 150 days.

Day 1	Day 2	Day 3	Day 4	Days 5–10
Introductory and **Before Reading Activities**	**During Reading Activity**		**After Reading Activity**	**STEAM Challenge** and **Assessments**

Option 2 includes only literacy activities. This option spans five instructional days and requires approximately 30–45 minutes a day, for a total of 37.5–56.25 hours over the course of 75 days.

Day 1	Day 2	Day 3	Day 4	Day 5
Before Reading Activity	**During Reading Activity**		**After Reading Activity**	**Assessment Activities**

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Amphibian Rescue

Unit 1
Animals & Ecosystems

Lesson Plan

Author
Allison Duarte

Smithsonian **STEAM Readers**
Science ■ Technology ○ Engineering ■ Arts ○ Mathematics

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References to digital components are included for educators who purchased the full kit: *Smithsonian Readers: STEAM: Grade 3*. Please disregard digital component references if this lesson was purchased in a different product configuration.

Answer Key: *Amphibian Rescue*

page 10—Connecting Images and Text

Responses will vary. Examples:

1. A scientist holds a frog and touches it with a cotton bud. The image helps me understand how scientists collect and test frogs without touching them.
2. A scientist stands in a rescue pod. The image helps me understand what rescue pods look like inside and how many tanks there are.
3. A device is attached to a frog. The image helps me understand the size and location of a tracking device put on frogs.

page 11—Amphibians in Danger

Responses will vary. Examples:

1. Droughts are long periods of no rain; Ponds and swamps dry up in periods of no rain; Most amphibians lay their eggs in the water of ponds and swamps.
2. Humans are destroying the habitat where amphibians live; New buildings take the place of swamps and ponds; Amphibians in these places are losing their homes.
3. The chytrid fungus infects the skin of frogs; It can be spread through touch and water; The fungus has killed dozens of frog species.

page 17—*Amphibian Rescue* Quiz

1. A
2. B
3. A
4. D
5. The images show examples of frogs with different camouflage. One frog has bright colors, and one blends in.

Amphibian Rescue

Materials

- *Amphibian Rescue* books
- copies of student activity sheets (pages 9–19)
- drawing paper
- **STEAM Challenge materials include but are not limited to the following:**
  - ✓ aluminum foil
  - ✓ cardboard pieces (various sizes)
  - ✓ cheesecloth
  - ✓ craft sticks
  - ✓ glue
  - ✓ masking tape
  - ✓ plant matter
  - ✓ plastic frogs or small objects to represent frogs
  - ✓ plastic rings: 2.5–5 cm (1–2 in.)
  - ✓ plastic storage bin with a shallow dish of water
  - ✓ rubber bands
  - ✓ sandwich bags
  - ✓ scissors
  - ✓ soil
  - ✓ straws

Learning Objectives

- **Reading:** Use information gained from illustrations and the words in a text to demonstrate understanding.
- **Writing:** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
- **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

Nearly half of all amphibian species are at risk.

Lesson Timeline

Day 1	Day 2	Day 3	Day 4	Day 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 use illustrations in the text to make predictions.	Research frogs and the chytrid fungus, use images to reinforce understanding of the text, and brainstorm design solutions.		Gather and categorize notes about why amphibians are in danger.	Design, build, test, improve, reflect on, and share a tool to collect frogs. Complete the assessments.

Amphibian Rescue (cont.)

STEAM Vocabulary

amphibians	camouflage	extinct
fungus	predators	wetlands

Introductory Activity

Define the Problem

1. Display the image and read the captions on page 15 of the *Amphibian Rescue* book. Ask students to record four observations and two questions about the image. Divide the class into pairs to discuss their notes. Ask them to choose an interesting observation or question to share with the class. Tell students that the STEAM Challenge relates to the image and ask them to predict what they might have to do in the challenge.
2. Distribute the *Amphibian Rescue* books to students. Reveal the STEAM Challenge by reading aloud pages 28 and 29 of the book.
   - 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 tool that can* _____ *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 and explain their meanings. Distribute drawing paper to students. Have students create flip-books with words and pictures that describe the vocabulary words. Have students share and compare their flip-books with partners. Have students save their flip-books to support comprehension while reading.
2. Discuss with students that both words and images provide the reader with new information in a nonfiction text. Explain how images and the words in a text work together to help readers understand a text. Tell students that the images in a text can be used to preview and make predictions about the text. Flip through the book to look at the images. Ask students to make predictions about the text based on the images they see.

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Amphibian Rescue (cont.)

During Reading

Research and Brainstorm

1. Distribute the *Amphibian Rescue* books to students. Read pages 4–7 aloud, stopping to discuss how the photos on the pages help readers better understand the text. For example, discuss how the photo on page 6 supports the text and helps the reader better understand where frogs lay eggs and what they look like.
   - 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 *Connecting Images and Text* (page 10) to students. Have students read the book in pairs and complete their activity sheets 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 discuss the meaning of each word. Sort students into six groups, and assign each group a different word. Ask groups to create a skit about their word. Allow time for groups to create and practice their skits. Then, have students perform their skits and ask for the class to guess which word the skit represents.
2. Tell students that scientists and engineers often conduct research to build their knowledge about a topic before starting new investigations. Explain that scientists and engineers gather information from various sources and organize what they find by taking notes and sorting ideas into categories.
3. Distribute *Amphibians in Danger* (page 11) to students. Tell students they will act as scientists interested in learning about why amphibians are in danger of extinction. Explain that they will take notes on ways frogs are threatened and sort the notes into categories. Have students work in pairs to collect and sort their notes.
   - Support **below-level learners** by focusing their notes on two of the three categories. You may choose to do the activity with them.
   - Challenge **above-level learners** to sort each category into sub-categories.

Amphibian Rescue (cont.)

Prep

- Review all designs prior to building.
- Prepare a model frog habitat in a plastic storage bin with a water bowl, plant matter, and soil. Place two plastic frogs or similar objects in the bin for each team to collect: one in the water and another outside of the water.
- Prepare all materials for the STEAM Challenge.

STEAM Challenge

Design and Build

1. Discuss the following questions as a class to connect the reading to the STEAM Challenge:
   - *Why do scientists in Panama avoid touching frogs?* Guide students to the idea that since the chytrid fungus lives on the skin of frogs, scientists avoid touching the frogs.
   - *What tool do scientists currently use to catch frogs?* Have students refer to pages 14 and 15 to describe how and why plastic bags are used to catch frogs. Ask students to look carefully at the image and to suggest the pros and cons of this method.
2. Distribute previously completed activity sheets to students. Review the STEAM Challenge on pages 28 and 29. List materials on the board and show students the model habitat with objects that will represent frogs.
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 each member share their designs. Then, have groups choose, sketch, and label a team design. (Team designs must be submitted for approval before building.)
   - Challenge **above-level learners** by adding constraints or criteria (e.g., the tool must keep a frog's skin moist).
5. Explain to students that when they build their tools, they must follow their design plans. Reassure them that they will have an opportunity to change and improve their designs after they test them. Review classroom expectations for working with materials. Give teams time to build their tools.
   - You may choose to 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.

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Amphibian Rescue (cont.)

Prep

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

STEAM Challenge

Test and Improve

1. Discuss the following questions as a class to connect the reading to the STEAM Challenge:
   - *What types of experts work together to collect and care for frogs at the rescue lab in Panama?* Point out that scientists, researchers, and veterinarians work together to gain knowledge and help frog populations in Panama. Encourage students to listen to others and share ideas during the STEAM Challenge.
   - *What are scientists at the rescue lab doing to find new ways to save frogs?* Guide students to the idea that scientists continue to search for ways to solve the fungus problem, including applying bacteria to the skin of frogs and tracking them in the wild. Explain to students that they will also have a chance to learn from and improve their designs.
2. Invite teams to bring their tools to the model frog habitat. Explain that they will offer feedback after each test. Use *Friendly Feedback* (page 14) to review best practices for giving feedback.
3. Distribute *Frog Catching Test Results* (page 15) to students. Ask them to record the results for each team as they perform their tests. Have one student from each team use their team's tool to catch an object in and out of the water bowl while all other students observe. If a tool collects both objects, the design is successful. Ask volunteers to give friendly feedback.
4. Allow time for teams to brainstorm ways to improve designs based on feedback and test results. 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 **above-level learners** and successful teams with additional constraints or criteria for the second design (e.g., tools must also transport frogs without risk of escape, tools must reach frogs from a distance).
5. Have teams gather materials to improve their designs. Then, have them retest their tools.
6. Have students answer questions 3 and 4 on their *Think about It* activity sheets.

Amphibian Rescue (cont.)

STEAM Challenge

Reflect and Share

1. Ask half the class to form a circle facing outward. Then, have the other half form a circle facing them, creating inner and outer circles.
2. Have students reflect on their STEAM Challenge experiences by asking a question from the *Think about It* activity sheet. Have students discuss their responses with the person in front of them. Ring a bell or give students a signal for the outside circle to rotate one person to the left. Repeat this activity with the rest of the questions or create your own.
3. Distribute *Engineering Design Process* (page 16) and review how students used each step 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 helping amphibians.

Assessment Activities

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

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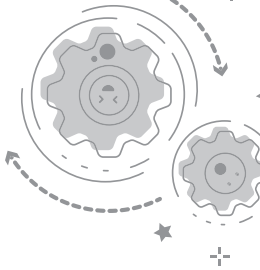

Make a Plan

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

Challenge: _____

_____

Brainstorm

Design 1

Design 2

Name: _____ Date: _____

Connecting Images and Text

Directions: Describe each image. Explain how each image helps you understand the text.

1. Frog and Scientist, page 15

Description: _____

How it helps you: _____

_____

_____

2. Rescue Pod, page 19

Description: _____

How it helps you: _____

_____

_____

3. High-tech Frog, page 27

Description: _____

How it helps you: _____

_____

_____

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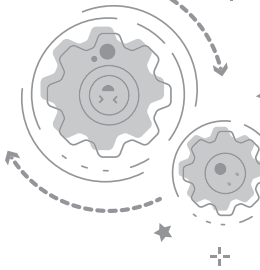

Amphibians in Danger

Directions: Find information from the text about threats to frogs. Write the information you find for each category.

1. Droughts

-
-
-

2. Habitat Loss

-
-
-

3. Chytrid Fungus

-
-
-

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

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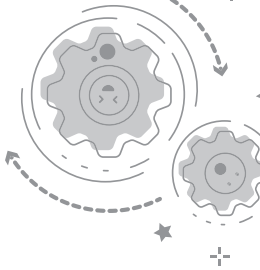
Name: _____ Date: _____



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 the challenge, I learned _____

_____

I liked _____

It was hard when _____

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 _____ .

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Name: _____ Date: _____

Frog Catching Test Results

Directions: Write the materials each team used. Mark results of each team's test by circling *yes* or *no*. Then, answer the questions.

Team	Materials	Did the tool catch both frogs?
		yes/no
		yes/no
		yes/no
		yes/no
		yes/no
		yes/no

What tool do you think was most successful? Sketch it below.

What ideas will you use from this tool to improve your own?

_____

_____

_____

_____

_____

_____

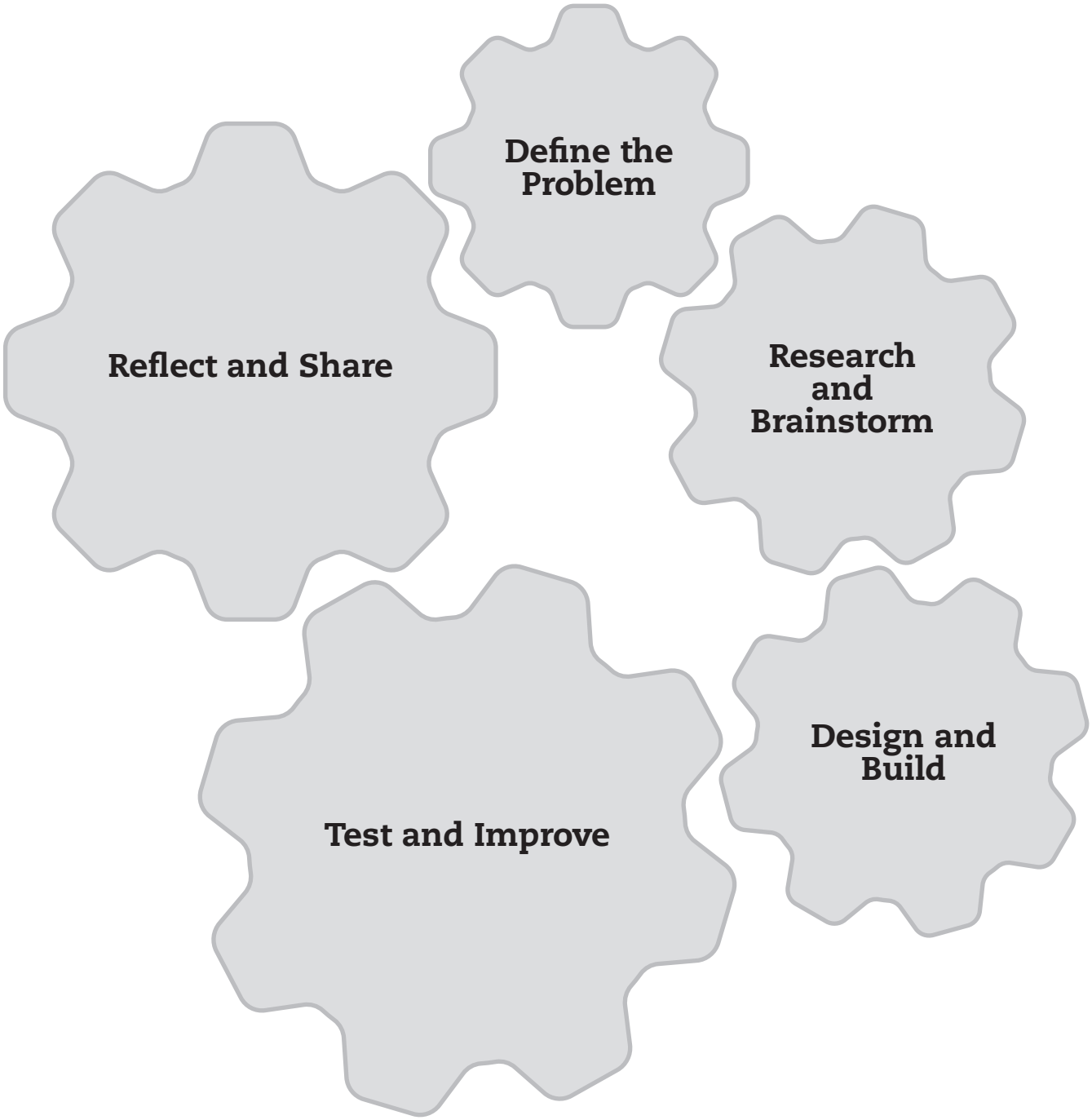
_____

_____

_____

Name: _____ Date: _____

Engineering Design Process



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Name: _____ Date: _____

Amphibian Rescue 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. How does the image on page 26 support the text?

- (A) It shows how frogs are transported.
- (B) It shows where frogs are released.
- (C) It shows how scientists handle frogs in the lab.
- (D) It shows harlequin frogs in a cloud forest.

2. Frog species are in danger for all the following reasons *except*:

- (A) a fungus
- (B) long periods of rain
- (C) loss of habitat
- (D) droughts

3. Which image would most likely appear with text explaining what frogs eat in the wild?

- (A) a frog catching a fly
- (B) a frog escaping from a predator
- (C) a scientist capturing a frog
- (D) a frog wearing a tracking device

4. Many different species of frogs are affected by the chytrid _____.

- (A) bacteria
- (B) amphibians
- (C) predators
- (D) fungus

5. How do the images on page 17 support the text?

_____

_____

_____

_____

Name: _____ Date: _____

Teamwork Rubric

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

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				

Comments: _____

_____

_____

_____

_____

_____

_____

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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.

Test and Improve

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

Reflect and Share

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

STEAM CHALLENGE

Define the Problem

Scientists in Panama want to develop another tool to catch frogs in the wild. They found that the chytrid fungus spreads to scientists' skin too easily with the current method. Can you create a safe and effective tool?

Constraints: Your design must be created using everyday household items and materials.

Criteria: You will test your design by using the tool to collect an object in and around a water tank.

1 Research and Brainstorm

Where do scientists collect the frogs? What do scientists currently use to collect frogs? What are the most important parts of a tool to catch frogs?

2 Design and Build

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

3 Test and Improve

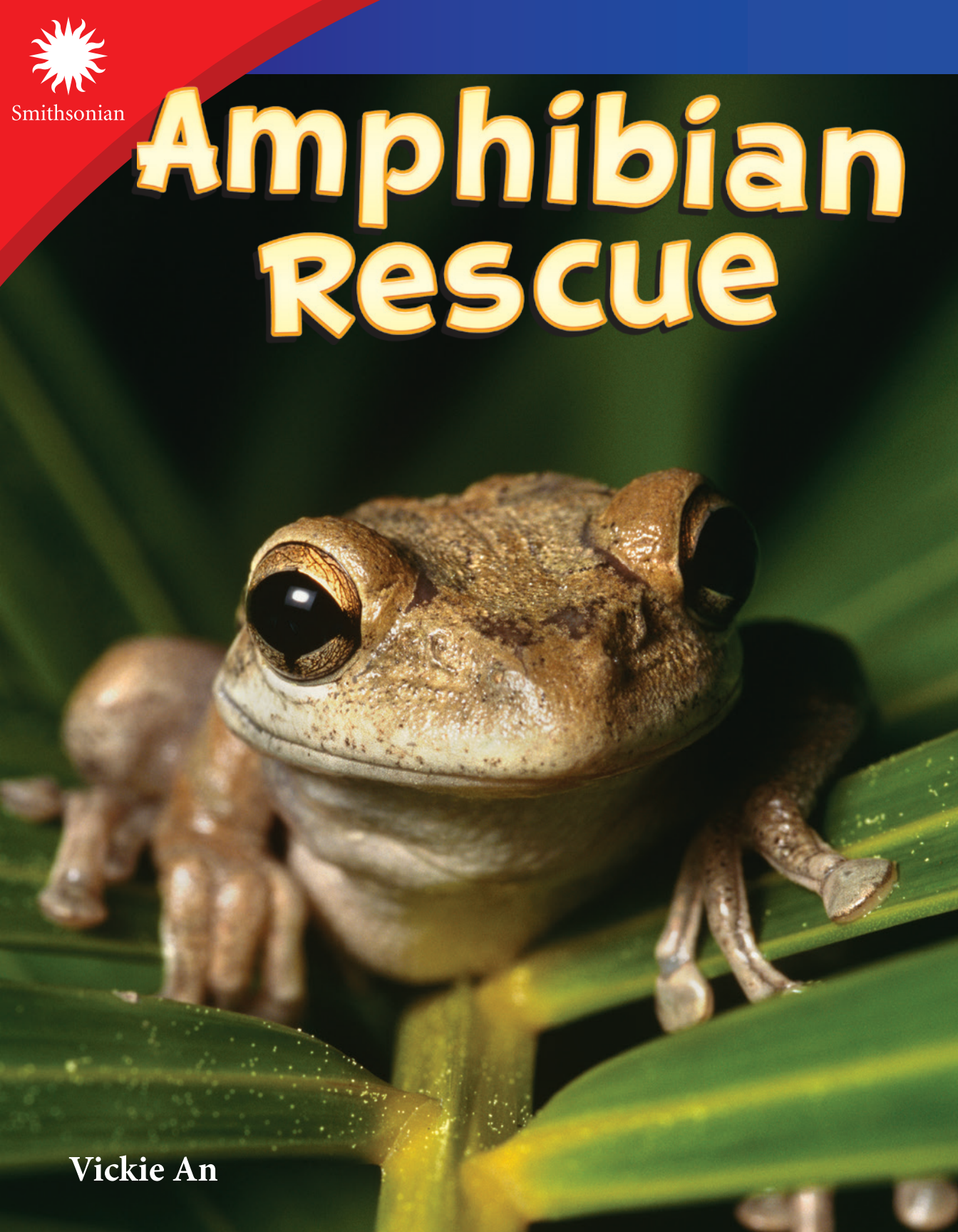
Use your tool to collect an object. Did it work? How can you improve your tool? Modify your design, and try again.

4 Reflect and Share

Is the model strong enough to be used again? What other materials could you use to make a tool? Could the scientists use this tool for something else?

Smithsonian

Amphibian Rescue



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Awesome Amphibians

Frogs, toads, newts (NOOTS), and salamanders are pretty amazing. Did you know that frogs and toads use their eyes to push down food when they swallow? Did you know that salamanders and newts can grow new **limbs**? There are also some frogs that can jump 20 times their body length. But, all of these animals have something in common. They are all **amphibians** (am-FIH-bee-uhnz).

Amphibians comes from Greek words. *Amphi* means "two" or "both." *Bios* means "life." Amphibians lead two lives. Most spend part of their lives in water. But they also spend time living on land.

Amphibians can be found all over the world. They live in streams, rain forests, deserts, and everywhere in between. There are more than 7,500 kinds of amphibians. Many of them are in danger. But help is on the way.

The Chinese giant salamander is the biggest amphibian in the world. It can grow up to 1.8 meters (6 feet) long.

Tadpoles grow up to be frogs that live on land.

Red-spotted newts are amphibians.

A Vanishing Act

Scientists are worried about amphibians. More than 120 kinds of frogs and salamanders have gone **extinct** in the past 40 years. That means they have all died. They no longer exist. Nearly half of all amphibian **species** are at risk. Now, there's a race to save them.

Almost all amphibians have thin, moist (MOYST) skin. They drink through their skin. Their skin also helps them breathe. This makes them sensitive to their surroundings. Even a slight rise in temperature can have a big effect on amphibians.

Hot weather can lead to droughts (DROWTS). These are long periods of no rain. Ponds and swamps dry up. Most amphibians lay their eggs in water. When ponds dry up, they have no place to go.

A frog lays its eggs.

Frogs have tongues that attach to the fronts of their mouths, not the backs like humans. When they hunt, they flip out their tongues to catch food.

More Troubles

Loss of habitat is another problem. A habitat is the home of an animal. Humans are destroying the areas where amphibians live. They are cutting down forests and draining **wetlands**. They want to use the land to build houses, farms, and shops. New buildings take the place of swamps and ponds. As a result, amphibians are losing their homes. Frogs have had it especially hard.

Why Does It Matter?

A decrease in the number of frogs can cause big problems. Frogs play a key role in the food chain. They eat all kinds of insects. Imagine how many more bugs would be buzzing around if not for frogs. Frogs are also food for birds, reptiles, and mammals. Plus, frogs tell us a great deal about the health of an environment. How? When they start dying in large numbers, it's a sign that something is wrong.

Construction damages these wetlands.

Amphibians are cold-blooded. This means they cannot control their body temperature on their own. Amphibians often warm themselves by sitting in the sun.

A frog eats an insect.

One of the biggest dangers frogs face is from a **fungus**. This deadly fungus is called *chytrid* (KIH-trihd). It infects the skin. The fungus can spread by touching infected skin. It can also be spread through water. The disease moves fast. It has killed dozens of frog species. Hundreds more may soon be gone, too.

No one knows where the fungus came from. Humans transport frogs all over the world. The fungus could have come from anywhere. Some people think it is from Africa. It might have spread from there since many labs use African clawed frogs for research. Other people think American bullfrogs are to blame. Their legs are served in restaurants around the world. Wherever the fungus is from, it is now found almost everywhere frogs live.

The lemur tree frog is one species threatened by the chytrid fungus.

This wood frog may have died from the chytrid fungus.

SCIENCE

A Fungus Among Us

Chytrid changes a frog's skin. Since a frog breathes and drinks through its skin, an infected frog can die within months.

The Fight for Frogs

Scientists are not giving up on frogs. Some of them are working to save frogs in Panama. Panama is in Central America. It has a warm, wet climate. A large part of the country is covered in rain forests, **cloud forests**, and wetlands. More than two hundred species of amphibians live in Panama.

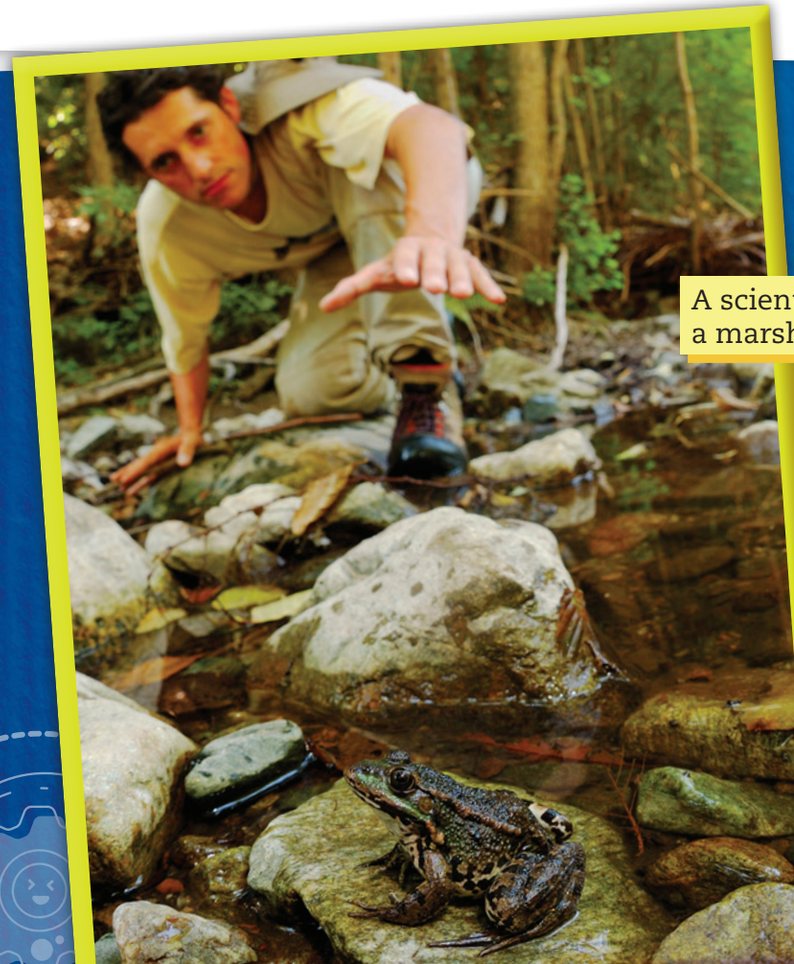
Sadly, it is too late for some frogs. Some species have not been seen in years. Panama's harlequin (HAHR-lih-kwihn) frogs and glass frogs are in trouble, too. These are just a few of the frogs that the chytrid fungus has harmed. But there is still hope. Scientists have opened a rescue lab. It is the biggest of its kind.

A young woman works at a rescue lab for amphibians in Panama.

The skin of one Panamanian golden frog contains enough poison to kill 1,200 mice.

To collect frogs, teams of researchers go into the wild. They go to places where they think the fungus has not reached. They know that the fungus spreads through water. Research shows that it grows faster in cooler weather, too. So, frogs that live in cool mountain streams are most at risk.

No special traps are needed to catch the frogs. Instead, scientists use something that can be found in most kitchens. Here is a hint: People use them to pack sandwiches for their lunches. That's right! Scientists put frogs in plastic bags. They are very careful not to touch the frogs. Scientists write when and where the frogs were found. Then, they take them to the rescue center.



A scientist studies a marsh frog.

Most of Panama was covered in rain forest until the Panama Canal was built in the twentieth century.

A scientist collects a sample from a frog.

Frogs can be very hard to find. Many have natural **camouflage** (KA-muh-flahj). They blend in with their habitat. This keeps them safe from **predators**.

So, instead of using their eyes, scientists use their ears. They can identify frogs from their calls. Each frog species makes a **unique** sound. It can be easy to know which frog is nearby if you know the sounds that it makes.

Like humans, frogs have vocal cords. They also have a vocal sac below their mouths. This sac fills with air and makes their calls louder. Some frogs can be heard 1.6 kilometers (1 mile) away. The frogs use their calls to attract **mates**, call for help, and scare off predators. They can sound like croaks, clicks, or whistles. There are even some species that sound like they are barking!

A tree frog prepares to call out.

poison arrow frog

spiny-headed tree frog

ARTS

Hide and Seek

Blending in is just one way that frogs use camouflage. Others do the opposite. Some frogs use **mimicry** (MIH-mih-kree) to stay safe. This is when a frog makes itself look more dangerous than it is. Some harmless frogs have learned to mimic the bright colors of poisonous frogs that live nearby. Their bright colors warn that they are deadly even though they aren't.

Building a Safe Home

Back at the lab, a lot of teamwork goes into caring for the frogs. Veterinarians make sure the frogs stay healthy. Scientists watch the frogs to learn about their behavior. Researchers study the fungus. Together, they learn more about frogs.

The rescue lab has three main parts. The first is a working lab for the researchers. The second is where the frogs are kept right after being brought from the wild. Here, frogs are watched to make sure they are not sick. Finally, there are the rescue pods. In all, the seven pods hold 12 endangered frog species.

Rescue lab workers make baths to help frogs fight chytrid.

There are many tanks in each rescue pod.

MATHEMATICS

How Many Frogs?

Designers had to plan for the number of frog habitats that could fit in each rescue pod. First, they measured the length of the pods. Next, they measured the length of the tanks used for the frog habitats. Finally, they divided the total length of the pods by the total length of the tanks. This told them the number of habitat tanks that could fit in each rescue pod.

When frogs arrive, they are tested for the chytrid fungus right away. If a frog is sick, it is given medicine. It is also cleaned with a special liquid. To be extra safe, it is kept away from other frogs for 30 days. This is called *quarantine*. The frog is then moved into a habitat made just for it. The environment in the lab must be perfect for the frogs to survive. It cannot be too hot or too cold. The humidity, or level of moisture in the air, must be just right. The amount of light is important, too.

As the pods fill, there are many hungry mouths to feed. Scientists raise all the food that the frogs eat. Crickets and fruit flies make up most of the menu.

A frog eats a fly.

A scientist holds a container with a frog.

ENGINEERING

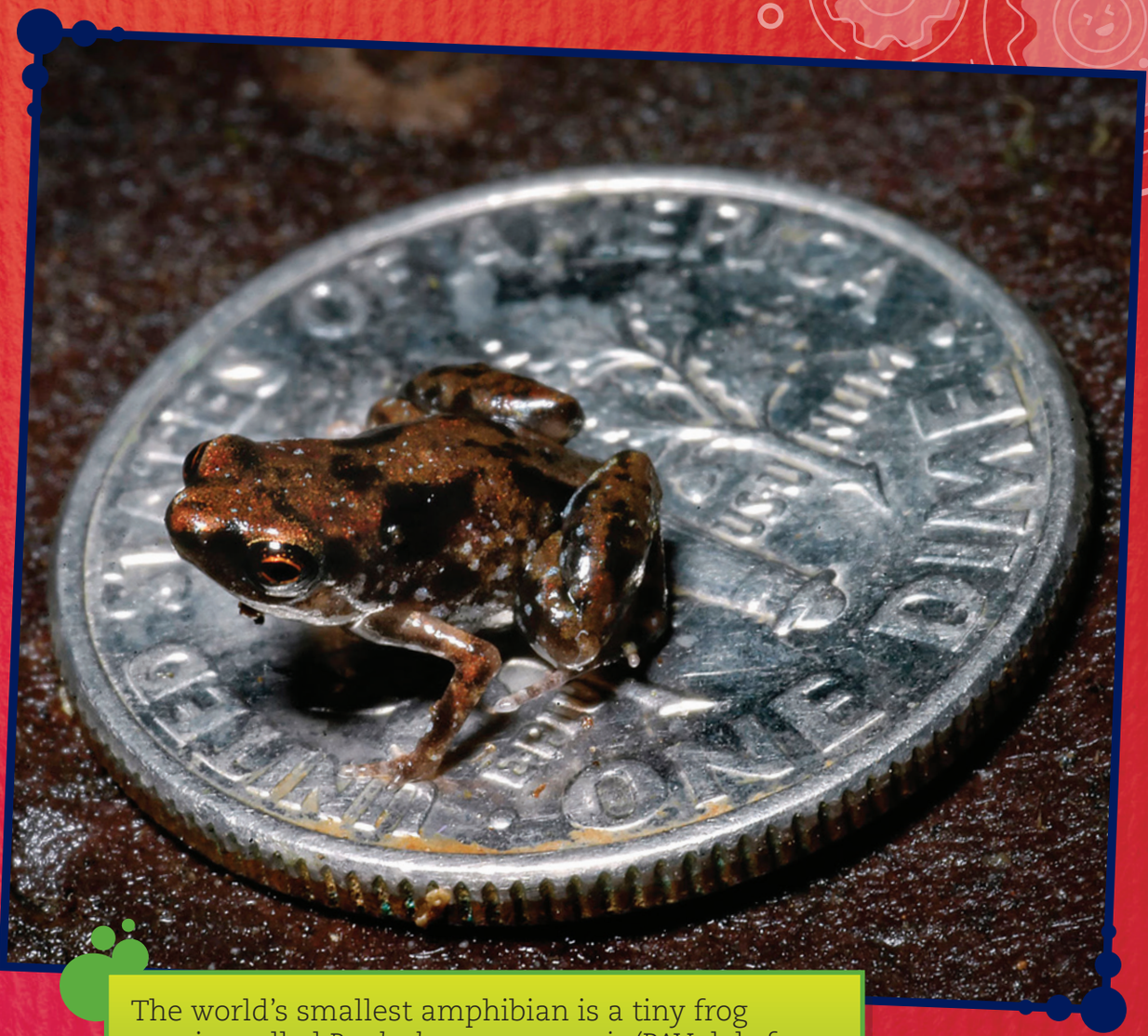
Reuse and Recycle

There are seven rescue pods at the lab in Panama. These new frog homes are built from old shipping containers. They were once used to move frozen goods all around the world. Engineers designed them to be used as mini-ecosystems for the frogs.

In some cases, the frogs at the research center are the last of their kind. One mission of the project is to breed the frogs. *Breed* means "to make offspring, or young." Scientists hope this will help save the species. So, if these frogs go extinct in the wild, the species will not be lost completely.

Scientists already have one win. They successfully bred a species of poison dart frog. The little froglet was the first of its kind to be hatched by humans. It is smaller than a dime! It was first discovered in Panama in 2014. These breeding programs have a goal. That goal is to release the frogs back to the wild some day.

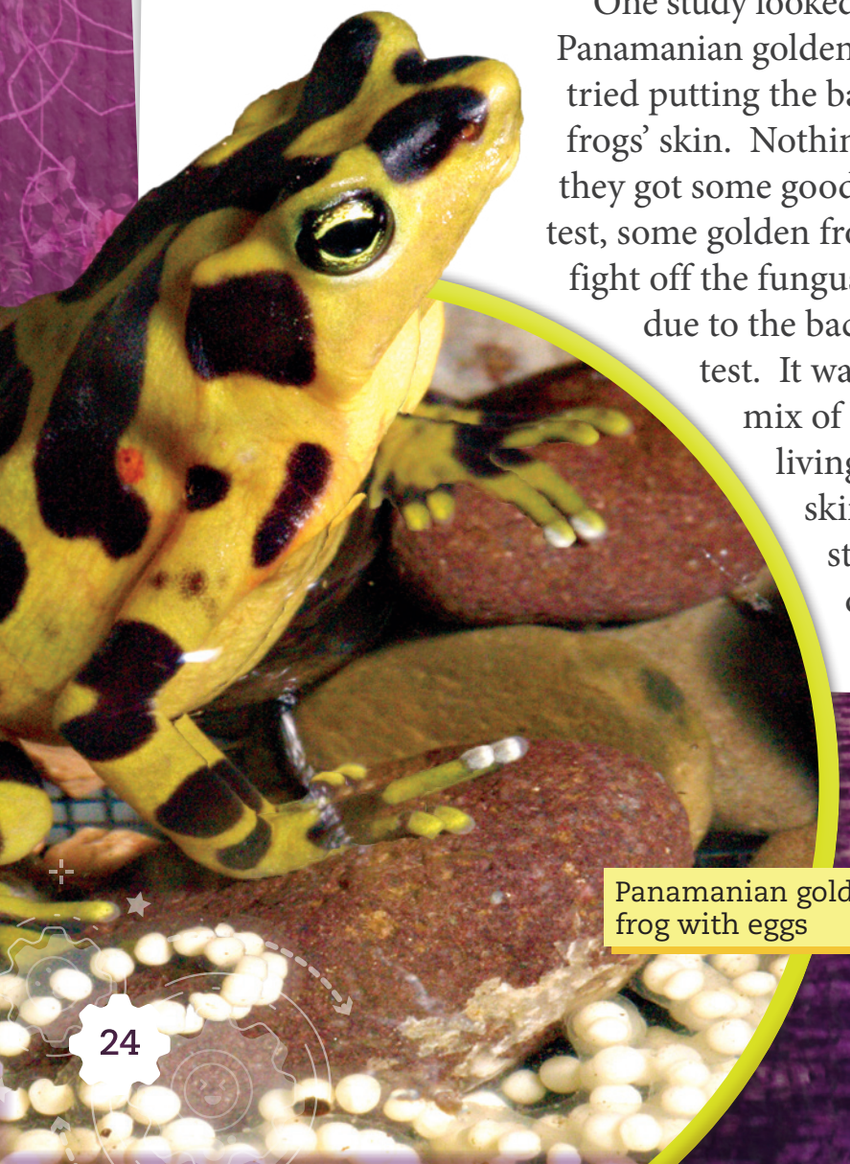
blue poison dart frog



The world's smallest amphibian is a tiny frog species called *Paedophryne amauensis* (PAY-doh-freen ah-mow-EN-sis). It is about the size of a housefly!

Researchers are working hard to solve the chytrid fungus problem. At first, they thought bacteria might help. There are good kinds and bad kinds of bacteria. The bad kinds can make you sick. But the good kinds can keep you healthy. Scientists tested the good kinds on the frogs. These bacteria were known to fight fungus. Could one of them save the frogs from the chytrid fungus?

One study looked at the Panamanian golden frog. Scientists tried putting the bacteria on the frogs' skin. Nothing worked. Then, they got some good news. In one test, some golden frogs were able to fight off the fungus. But it was not due to the bacteria used in the test. It was because of the mix of bacteria already living on the frogs' skin. More work still needs to be done to find an answer.



Panamanian golden frog with eggs

The Panamanian golden frog is extinct in the wild. Today, the frog only exists in labs and zoos.

Making Leaps!

Today, scientists in Panama still fight for frogs. The research lab recently took an exciting step. They released 90 harlequin frogs into the rain forest. The frogs were bred in the rescue lab. They want to see whether frogs raised by humans can live in the wild. Researchers will track them every day. They hope the study will help save the species. Maybe it can save others, too.

Scientists will keep looking for a cure for the chytrid fungus. The rescue lab has made a safe home for 12 endangered frog species. This will help keep some alive until they can solve the problem. For now, we will have to wait and see whether the frogs can be saved.

These frogs wait to be released into the rain forest.

TECHNOLOGY

High-Tech Tracking

Some harlequin frogs were released wearing tiny radios. The radios helped scientists track the frogs. It was one of the first times they had been made for animals this small. The radios were tied around the frogs with a thin cord that fell off after a month. This was so the radios would fall off the frogs after the batteries died.

STEAM CHALLENGE

Define the Problem

Scientists in Panama want to develop another tool to catch frogs in the wild. They found that the chytrid fungus spreads to scientists' skin too easily with the current method. Can you create a safe and effective tool?

Constraints: Your design must be created using everyday household items and materials.

Criteria: You will test your design by using the tool to collect an object in and around a water tank.

1 Research and Brainstorm

Where do scientists collect the frogs? What do scientists currently use to collect frogs? What are the most important parts of a tool to catch frogs?

2 Design and Build

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

3 Test and Improve

Use your tool to collect an object. Did it work? How can you improve your tool? Modify your design, and try again.

4 Reflect and Share

Is the model strong enough to be used again? What other materials could you use to make a tool? Could the scientists use this tool for something else?

Glossary

amphibians—cold-blooded animals that are able to live on land and in water

camouflage—a way to hide by disguise

cloud forests—wet mountain forests that usually have many clouds

extinct—no longer existing

fungus—living thing that is not a plant or animal and lives in or on plants, animals, or decaying matter

limbs—arms, legs, or wings

mates—animals that are used for breeding

mimicry—protection from danger where an animal copies the coloring, look, or behavior of a more harmful animal

predators—animals that live by killing and eating other animals

species—a group of plants or animals that are similar and can produce young

unique—unlike anything else; special or unusual

wetlands—land or areas, such as swamps, having much soil moisture

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CAREER ADVICE
from Smithsonian

Do you want to help amphibians?
Here are some tips to get you started.

"As a kid, I loved reptiles and amphibians. This interest in herpetology stayed with me through high school and college, and now it's my career! Study biology and zoology, and spend time observing amphibians in their natural habitats. I learn something new about the animals I study all the time." ***—Brian Gratwicke, Ph.D., Conservation Biologist***

"It is an honor to work with an endangered species like the Panamanian golden frog. Taking care of these frogs means understanding their habitat and what they need to survive. It makes me feel good that I am doing something to help. If you love science, roaming outside, and being curious about nature, then you can help endangered frogs, too." ***—Matt Evans, Biologist***

Read and Respond

1. What are some of the things threatening frogs?
2. Why are amphibians important?
3. How do scientists find frogs in the wild?
4. What might happen if scientists touch frogs after they are captured?
5. What is the most important thing that the rescue lab in Panama has done?
6. Brainstorm ways that scientists can protect frogs from the chytrid fungus in the future.