



The Frog Scientist 1: The Mystery of Disappearing Frogs

WHAT YOU NEED

- **The Frog Scientist**

ESHEET | AUDIO

- **The Frog Scientist**

STUDENT ACTIVITY SHEET

- **Frogs: The Thin Green Line**

STUDENT ACTIVITY SHEET

- **Frog Scientist Interview**

STUDENT ACTIVITY SHEET | AUDIO

- **The Frog Scientist Teacher Sheet**

TEACHER SHEET

- **Frogs: The Thin Green Line Teacher Sheet**

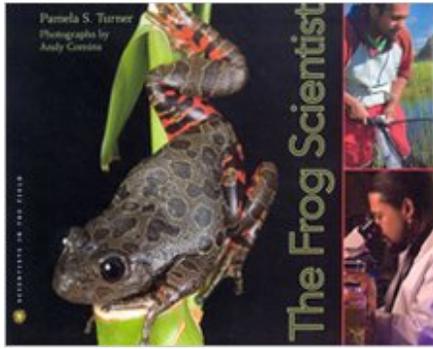
TEACHER SHEET

MATERIALS

- Classroom copies of *The Frog Scientist* by Pamela S. Turner

PURPOSE

To develop an understanding of how scientists go about their work by examining the work of a scientist who studies the effects of environmental pesticides on frogs.



CONTEXT

This lesson is the first of a two-part series focused on how scientists perform their work. These lessons make use of a book called *The Frog Scientist*, by Pamela S. Turner. This book is one of the winners of the **2010 AAAS/Subaru SB&F Prize for Excellence in Science Books** (<http://www.sbsonline.com/Subaru/Pages/PrizesHome.aspx>).

The lessons emphasize the nature of scientific inquiry with the learning goals being value and attitudinal based; these concepts are learned over the course of many lessons. The Frog Scientist lesson series can be used for the reinforcement and application of existing student knowledge. For example, students at the middle-school grade level should understand what a hypothesis is and be able to develop one. Additionally, students should have some science lab experience, including making and recording observations.

Students commonly view scientific work as something that is performed in laboratories by scientists in lab coats. The book shows how a scientist not only conducts experiments in the laboratory but also works outdoors in the field making observations and collecting specimens. It is recommended that before beginning the lesson, conduct a brief review of key concepts in ecology, including the definitions of habitat, ecosystem, population, species, pollution, and conservation. Review with students that frogs are amphibians, pointing out the distinguishing characteristics of amphibians and additional animal species that are classified as amphibians. It also would be helpful to review the definitions for data, observations, explanation, evidence, and experimentation.

The Frog Scientist is an engaging, well-written book that provides a realistic and accurate picture of what scientists do and how they do it. The book is filled with Andy Comins' dazzling photography of many frog species as well as the people who study them. The book profiles Dr. Tyrone Hayes, providing a well-rounded view of him as a scientist, activist, mentor, and family man. Students will learn about Dr. Hayes' scientific research into the possible connection between atrazine, which is the most commonly used agricultural weed killer, and the feminization of male frogs. The book provides a realistic view of the scientific process showing how it can be highly stimulating, frustrating, and rewarding. Through Dr. Hayes' example, one sees the passion, commitment, and persistence that scientists can have for their work, not only for the joy of discovery but also for the ways in which they can make a difference by improving the living environment and the health of the species that live in it.

The Frog Scientist 1: The Mystery of Disappearing Frogs introduces students to Dr. Tyrone Hayes. Students will see how scientists do their work and how that work not only helps our understanding of the natural world but also is important for protecting both animals and their habitats. Using *The Frog Scientist* and related resources, the lesson shows how scientists engage in scientific inquiry, including the formation of hypotheses, making observations, and the collection, analysis, and interpretation of data.

The Frog Scientist 2: Schoolyard Field Investigation, allows students to apply the knowledge and skills acquired in the first lesson to developing a hypothesis, conducting their own scientific inquiry, and reporting their results just as working scientists do. Students will engage in scientific inquiry by conducting their own field investigation, presenting their findings in a scientific poster, and engaging in scientific peer review.

Use the lessons to address common grade-level misconceptions about scientific inquiry, including: that students might not understand the difference between a description of evidence and interpretation of evidence; that experimentation is a method of testing ideas, rather than a method of trying things out or producing a desired outcome; that knowledge or ideas are not necessarily right or wrong—scientists can legitimately hold different explanations for the same set of data; the scientific method is not a linear/rigid process but follows a logical progression from question to hypothesis to experimentation, etc.; and when interpreting data it is important to avoid only focusing on evidence that confirms their current beliefs and concepts (i.e., personal explanations) and ignoring evidence that does not agree with their ideas. (*Science for All Americans*, pp. 1-12 (<http://www.project2061.org/publications/sfaa/online/chap1.htm#inquiry>) and National Science Education Standards, pp. 143-148 (http://www.nap.edu/openbook.php?record_id=4962&page=143).

Ideas in this lesson are also related to concepts found in these Common Core State Standards:

CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

PLANNING AHEAD

Before teaching this lesson, please read *The Frog Scientist* and watch the **Frogs: The Thin Green Line** (<http://www.pbs.org/wnet/nature/episodes/frogs-the-thin-green-line/video-agricultures-effect-on-frogs/4848/>) video segment featuring Dr. Tyrone Hayes. Students also should be assigned the book to read before starting this lesson.

MOTIVATION

To initiate the lesson, engage students to think about the importance of environmental conservation and the nature of scientific inquiry, including hypothesis formation, making and recording observations, performing lab experiments, collecting data, and interpreting results by directing them to the **Frog Scientist** student esheet and have them watch an online video segment from the Nature episode **Frogs: The Thin Green Line** (<http://www.pbs.org/wnet/nature/episodes/frogs-the-thin-green-line/video-agricultures-effect-on-frogs/4848/>). Alternatively, the video can be shown to the entire class. This six-minute segment shows how Dr. Hayes and his students go about conducting their research, including investigations into the apparent feminization of male frogs by the agricultural herbicide atrazine. This video is an excellent companion to *The Frog Scientist* book. Dr. Hayes also speaks about the nature of research, his interest in frogs, and citizen science. After the video, have students answer questions about the video on **Frogs: The Thin Green Line** student sheet. They can work individually, in pairs, or small groups of 3-4. After the worksheets are completed, lead a class discussion of the video. Answers to the questions have been provided on the **Frogs: The Thin Green Line** teacher sheet.

DEVELOPMENT

This part of the lesson focuses on *The Frog Scientist* book and engages students to think more deeply about scientific inquiry and environmental conservation. At this point, students should have completed reading *The Frog Scientist*. Before they start the book activity, students should use their Frog Scientist student esheet to listen to a **podcast interview with The Frog Scientist author Pamela S. Turner and photographer Andy Comins** (http://www.sbsonline.com/BookTalk/Documents/Turner_Comins.mp3). After listening to the podcast, lead a class discussion using these suggested questions:

What was it like for the book's author to hunt frogs with Tyrone Hayes?

(He is an expert frog "napper" and has been catching frogs, snakes, and turtles since he was a kid growing up in South Carolina)

Where were the book's author and Tyrone Hayes searching for frogs and what type of frogs were they trying to catch?

(They were in a swamp in Wyoming and they were trying to catch juvenile frogs.)

What is special about the relationship between Tyrone Hayes and his students?

(According to the interviewer, he seems to have a great relationship with his students and the book shows how camaraderie and friendship can be part of the scientific experience; Pamela Turner mentioned that Tyrone invites his students to his house for dinner.)

What important concepts does the book discuss?

(It discusses the methods of scientific research and the effects of the chemical atrazine on frogs as well as the importance of experimental design.)

What important experiments did Tyrone Hayes perform?

(He artificially contaminated a pond in Wyoming with atrazine, which he had a permit to do, and followed the frogs from that pond as well as raised frogs in his lab from eggs removed from the pond before adding atrazine.)

How does the book's author describe what science is?

(Science is an argument and one experiment is not the last word on a subject; every experiment is often a voice in an argument; Tyrone's work is a voice for what we should do about pests in the environment.)

Where did author Pamela Turner's interest in science come from?

(She always loved animals; she likes science because it allows one to admit there is a wider world beyond humans.)

Before students begin the book activity, they can review the **SB&F Book Club Guide: The Frog Scientist (http://www.sbfonline.com/Documents/BookClubGuide_FrogScientist.pdf)**. The two-page guide summarizes what the book is about, who wrote it, and why students should read it. Students can refer to the esheet to access the guide online or you can provide them with printed copies.

For the book activity, instruct the students that they will work cooperatively in small

groups to answer questions about Dr. Hayes, the problems faced by amphibians, and the research carried out by Dr. Hayes and his students. Each student group will be assigned a set of questions corresponding to a particular chapter of *The Frog Scientist* (question set 1 corresponds to chapter 1, question set 2 corresponds to chapter 2, etc.). Tell the students that, in addition to the book, they can use online resources on the esheet to answer their assigned questions or to learn more about things about which they are curious. They should record their answers on **The Frog Scientist** student sheet after which each group will discuss their answers with the class (you can use **The Frog Scientist** teacher sheet to help you find the information in the book). Longer chapters with more complex topics can be assigned to advanced learners while shorter chapters can be assigned to less advanced or struggling learners.

Let the students know that the purpose of this activity is for them to understand that scientific investigations involve collecting evidence, using logical reasoning, and applying imagination to come up with hypotheses and explanations for collected evidence. They also will see that hypotheses have value even if they turn out to be incorrect. Additionally, as exemplified by Tyrone Hayes' work, different kinds of questions require different types of scientific investigations: some involve observing and describing objects, organisms, or events; others involve collecting specimens while others involve experiments. Also discuss citizen science with the students to highlight the concept of global interdependence. Explain that citizen scientists are individuals who are interested in helping with the collection and analysis of data; development of technology; testing of natural phenomena; and the dissemination of these activities. Highlight that anyone, including the students, can be citizen scientists. Point out that there are many opportunities for them to get involved as individuals, groups, or a class.

ASSESSMENT

Since reading *The Frog Scientist* is a prerequisite for lesson, have the students write a brief summary of the book to assess their comprehension and recollection of the book. Use identified knowledge gaps as a guide for review.

As a quick formative assessment, give the students the following writing prompt as an individual assignment: Think about the type of scientific investigations performed by Tyrone Hayes and his students. Compare and contrast scientific bench work in the lab with field work outdoors by listing which skills you think are more important for each type of research as well as which skills are common to both types of research. Students should explain their answers.

You also can assess student understanding by considering student participation in

class discussion and answers to questions on the Frogs: The Thin Green Line student sheet.

EXTENSIONS

Follow this lesson with the second lesson in the series: **The Frog Scientist 2: Schoolyard Field Investigation**.

These Science NetLinks resources can be explored for more information on environmental issues, threatened species, and citizen science:

African Americans in Science

How We Know What We Know about Our Changing Climate

What Do Scientists Do?

These other resources also can be explored for more information on frogs, environmental issues, and citizen science.

Frogs: The Thin Green Line Video: Behind the Scenes

(<http://www.pbs.org/wnet/nature/episodes/frogs-the-thin-green-line/video-behind-the-scenes/4841/>)

National Wildlife Federation Wildlife Conservation-Citizen Science

(<http://www.nwf.org/Wildlife/Wildlife-Conservation/Citizen-Science.aspx>)

Kids Count: Young Citizen-Scientists Learn Environmental Activism

(<http://www.edutopia.org/service-learning-citizen-science>)

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1. The Frog Scientist 1: The Mystery of Disappearing Frogs

2. **The Frog Scientist 2: Schoolyard Field Investigation**

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