The Frog Scientist
by Pamela S. Turner
Photographs by Andy Comins
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# The Frog Scientist

by Pamela S. Turner

JLG Guide written by Linda Barr

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Pamela S. Turner says she writes for “my twelve-year-old self” about the things that interested her back then—and still fascinate her. She never tires of learning more about animals, the environment, and the people who try to help them both. Those people range from a frog scientist, to a gorilla doctor, to an astrobiologist. Her books take readers through swamps, across deserts, deep under the ocean, into outer space, and everywhere in between.

Ms. Turner’s hands-on research and lively writing has won many awards. For example, *A Life in the Wild* won the 2008 Golden Kite for best nonfiction children’s book. *Life on Earth—and Beyond* was selected as one of the best children’s books of the year by the Bank Street College of Education.

Like most writers, Ms. Turner loves to read. She learned to write her name at age four just so she could get her first library card. She also loves animals and learned much about them during the year she lived in Africa as a college student. After she married, her family lived in Japan, the Philippines, and other nations. In fact, her three children were each born in a different country!

In addition to writing, Ms. Turner volunteers at a wildlife hospital. Scuba diving allows her to get closer to the animals that live underwater, from sharks to sea slugs.

She and her family now live in California, where Ms. Turner is busy with several books that will be published soon. She also has written many articles about animals and people for *National Geographic Kids, Odyssey, Highlights for Children*, and other magazines. To find out more about Ms. Turner and her books and articles, check out her Web site: www.pamelastrurner.com.
Building Background: The Scientific Method

In this book, scientist Tyrone Hayes uses the scientific method to ask and answer a question. You might have used this same method in science class and elsewhere to figure out how things affect each other. Tyrone designs his experiments to see whether changes in one variable (water, in this case) cause changes in frogs.

These are the steps in the scientific method:

1. **Ask a question.**
   For example, you know that pesticides can damage the environment, but you still want to get rid of the bugs on your roses. You might ask, “Does ‘environmentally safe’ pesticide soap work as well as a traditional pesticide?”

2. **Form a hypothesis.**
   You have already tried pesticide soap, so you know it kills some of the bugs. You think you know the answer to your question. Your hypothesis is a statement: “Pesticide soap kills about half as many bugs as a traditional pesticide.” Your hypothesis is an educated guess about how things work.

3. **Design an experiment.**
   Now you think of an experiment that will determine whether your hypothesis is correct. You must make sure that only one variable—the bug killer—changes in your experiment. The other variables, such as the number, kind, and health of the bugs, must remain the same. For example, if you try out the pesticide soap on young, healthy bugs but spray the traditional pesticide on old bugs, your results may not tell you which pesticide works better. If you use more of the pesticide soap than the traditional pesticide, your results will not be about which pesticide works better, but how much more of one you used.

4. **Conduct your experiment.**
   Follow each step in your experiment, carefully recording what happens, including results that you did not expect.

5. **Draw conclusions.**
   Review your results. Did the pesticide soap kill half as many bugs as the traditional pesticide? If so, you might have other questions. For example, if you apply pesticide soap twice as often, will it kill twice as many bugs? You might need to plan another experiment!

<table>
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<th>Think About It</th>
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<tr>
<td>Why do scientists of all ages use this method?</td>
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<td>What kinds of things could you discover by using the scientific method?</td>
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Prereading Activities

Book Summary
As a boy in South Carolina, Tyrone Hayes loved to collect pond creatures, such as frogs, turtles, and snakes. Now he’s a graduate of Harvard University and a professor at the University of California, but he still likes frogs. Just as Tyrone began a serious study of frogs, scientists worldwide became aware that Earth’s frogs were dying. Tyrone has spent years trying to determine why we are losing frogs, focusing on the effect of pesticides on amphibians. This book follows Tyrone and his students as they collect and examine frogs to pinpoint the threats to their health, which also could be threats to human health.

Understanding the Genre: Nonfiction

1. What is the main difference between fiction and nonfiction?

______________________________________________________________________________

______________________________________________________________________________

2. If you were doing research before you wrote a book about frogs, what are some kinds of information sources you would use?

______________________________________________________________________________

______________________________________________________________________________

3. A book titled The Frog Scientist might fall into several genres besides nonfiction. What would you expect from a science-fiction book titled The Frog Scientist? From a fantasy book titled The Frog Scientist?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________
Prereading Activities

Activating Prior Knowledge
Fill in the first two columns of the KWL chart below to show what you know (K) about frogs and what you want to know (W) about them. Later you will fill in the last column to show what you learned (L).

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Know</td>
<td>What I Want to Know</td>
<td>What I Learned</td>
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Survey the Book
1. Read the table of contents. Why does this book include the special sections that start on page 52?

2. How is the table of contents different from the index?

3. How is the index different from the glossary?

4. What are “introduced species”? On which page can you learn more about them?
The Frog Squad
pages 1–7

Before You Read
Making Predictions
Look at the photos in this chapter. Who or what do you think the “frog squad” is?

After You Read
Mastering Vocabulary
1. You learned on page 2 that the scientific name for mayflies is Ephemeroptera, which means “lasting but a day.” If the pleasure of eating a cookie is ephemeral, what does that mean?

2. On page 4, find the words clutches and clutch. Which word has the familiar meaning? What is that meaning? What does the other word mean? (Look this word up in a dictionary if you cannot define it based on context clues.)

3. Also on page 4, find the phrase break down in the second long paragraph. Sometimes a car “breaks down” and needs repairs. Someone feeling very sad may “break down” in tears. Use context clues to determine the meaning of break down in this sentence.

4. On page 6, find the word feminized. You are familiar with the word feminine, so what does feminized mean?
Identifying Main Ideas
1. Write the one sentence in this chapter that summarizes the goal of Tyrone’s experiments.

2. Why is Tyrone concerned about frogs?

3. Why is Tyrone concerned only about male frogs?

Understanding Cause and Effect
To identify an effect, you can ask, “What happened?” To identify a cause, you can ask, “Why did that happen?” Often causes and effects form a chain. An effect becomes the cause of another effect. Use what you have learned in this chapter to complete this cause-and-effect chain.

Cause
Farmers use pesticide on their crops.

Effect

Effect

Cause
Drawing Conclusions
1. Why did Tyrone hike far into the Wyoming hills to find frogs for his experiment?

2. Why did Tyrone take some frog eggs out of the pond before adding a drop of atrazine?

3. Since pesticides might harm the environment, why do farmers use them?

4. The photo on page 6 shows labels for water samples. Why is this careful record-keeping important?

Making Connections
Would you enjoy being part of the “frog squad”? Why or why not?
After You Read
Making Inferences
1. How do you think growing up in the segregated South affected Tyrone?

2. Why might someone say that Tyrone graduated from college at just the right time?

3. Reread page 11. What three things will happen to the wood frog population if temperatures rise worldwide?

Making Connections
1. How was Tyrone’s childhood like yours? How was it different?

2. Which of your hobbies or interests might you continue as an adult? Could you turn any of them into a career, as Tyrone did? How?
Asking Questions
If you could, what two questions would you like to ask Tyrone about his childhood or college years?

1. ______________________________________

2. ______________________________________

Career Connection
Dr. Hayes is a biologist and herpetologist (a specialist who studies reptiles and amphibians). However, as a boy, he thought that a career in science meant being a doctor.

Look at the types of scientists' jobs below and find out what each one studies:

- marine biologist
- ecologist
- ichthyologist
- meteorologist
- toxicologist
- immunologist
- botanist
- etymologist

Use the Internet to learn more about careers in scientific fields that interest you. Then research colleges, especially those in your state, to find out where you could earn a degree in that career.

Make a chart showing the fields you selected and colleges where you might study them. Post your chart to share what you learn with classmates.
Before You Read
Introducing Vocabulary
Find each word below on the page listed. Infer its meaning from the context of the sentence or paragraph. Then confirm the meaning in a dictionary.

1. gastric (page 14)
2. brooding (page 14)
3. UV radiation (page 17)
4. parasite (page 18)
5. vulnerable (page 19)

After You Read
Analyzing Writing
In this chapter, the author uses these two similes:

- “The males . . . were golden orange, like web-footed tangerines.” (page 14)
- “Instead of chasing its prey, the Pac Man sits and waits like a web-footed couch potato.” (page 19)

These similes compare frogs to tangerines and couch potatoes. Choose a frog pictured in this chapter and, using a separate piece of paper, write a short paragraph about it. Do some research to learn about its diet, habitat, and so on so you can include that information in your description. In your paragraph, use a simile that compares your chosen frog to something “unfroglike.” Answers will vary.

Making Inferences
1. Why might the 1989 international conference have saved many amphibians from extinction?
2. Some frogs are born deformed. Why is that a problem?


3. All amphibians are cold-blooded. How does that affect them?


4. Why are some frogs dark and spotted, while others are brightly colored?


5. Why do introduced species often become a problem?


Making Connections
1. According to this author, what are the five main causes of the frogs’ decline?


2. Which of these causes are most likely to affect the frogs in your community?


Math Connection
On page 14, you learned that at least 122 of 5,743 species of amphibians have probably become extinct since 1980. What percentage of amphibians has become extinct? ______

At least 1,856 species are now threatened with extinction. What percentage of amphibians falls into this category? ______

What percentage of golden toads is now extinct? ______
The Amphibian Ark
pages 20–21

After You Read
Mastering Vocabulary
1. The word exotic has several meanings, including “a species that is not native to the place where it is found” and “different or unusual.” Which meaning of exotic is used in the next-to-last paragraph on page 21? Explain your answer.

_________________________________________________________________________

_________________________________________________________________________

2. Why does that paragraph also discuss Houston toads?

_________________________________________________________________________

Summarizing Information
1. What is the purpose of the Amphibian Ark?

_________________________________________________________________________

2. Why must the staff of the Amphibian Ark work quickly?

_________________________________________________________________________

Art Connections
Study the frog photos in the chapters you have read so far. Think about why each frog has its name. Then draw a new kind of frog and give it a name. (You can trace this frog for an outline if you wish.) Use colored pencils to indicate its color or markings. Add a sentence or two that explains why the name you chose suits your frog.
After You Read
Identifying Main Ideas and Details
Complete each main idea below. Then write two details that support the main idea.

1. It’s important to study atrazine because ______________

________________________________________________________________________

Detail: ____________________________________________________________________

________________________________________________________________________

Detail: ____________________________________________________________________

2. After experimenting with African clawed frogs, Tyrone decided to __________

________________________________________________________________________

Detail: ____________________________________________________________________

________________________________________________________________________

Detail: ____________________________________________________________________

Understanding Cause and Effect
As you know, an effect can become the cause of another effect. Use what you have learned to complete this cause-and-effect chain.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
<th>Cause</th>
<th>Effect</th>
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</thead>
<tbody>
<tr>
<td>Atrazine causes male frogs to grow eggs instead of sperm.</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Drawing Conclusions
1. Why didn’t Syngenta allow Tyrone to publish his results?

2. Why would about 33 percent of male frogs in some places be feminized, while more than 90 percent of males in other places were feminized?

3. Why does the author mention that our drinking water is considered safe if it contains three parts per billion of atrazine?

Health Connection

Atrazine seems to disrupt a frog’s endocrine system. How might it affect humans? Use your health textbook or another source to answer these questions:

1. How is a frog’s endocrine system similar to yours?

2. Where are testosterone and estrogen produced in the human body?

3. What might happen if a boy’s testosterone was changed into estrogen?
Before You Read
Predicting
Think about the title of this chapter. What do you think is Tyrone’s question?

After You Read
Identifying Main Ideas
1. Scientists set up experiments with carefully controlled variables. What is the manipulated (changing) variable in Tyrone’s experiment?

________________________________________________________________________

2. What are variables that do not change during this experiment?

________________________________________________________________________

________________________________________________________________________

3. Why does Tyrone very carefully mix the water for his experiment?

________________________________________________________________________

________________________________________________________________________

4. Why is Tyrone the only person who mixes the water?

________________________________________________________________________

________________________________________________________________________
Making Inferences
1. Why was it unlikely that Dugway Pond had already been contaminated with atrazine?

2. What if Dugway Pond had already contained atrazine? How would that have affected this experiment?

3. Why was it important that all of the frog eggs come from Dugway Pond?

4. How would the experiment be affected if the eggs came from different ponds?

5. When the students collected frogs from Dugway Pond, why did they collect water from where the frogs were living, too?

6. This experiment examines the effect of atrazine on growing male frogs. How might this same pesticide affect growing female frogs? Explain your response.
Synthesizing Information
1. What scientific skills are Tyrone’s students learning as they carry out this experiment?

2. What personal skills are Tyrone’s students learning?

Making Connections
1. How do you know that Tyrone cares about his students?

2. Why do you think many students struggle in their first year of college?

Checking Predictions
Review your prediction on page 14 of this study guide. Were you correct? What was Tyrone’s question?
Applying Knowledge
You are planning an experiment on plant growth. Some people think that coffee grounds help plants grow. You want to find out if that is true.

1. What is your hypothesis? Remember that a hypothesis is a statement, not a question. You are predicting the results of your experiment.

2. What is your manipulated variable?

3. What is your control group?

4. What are three of your controlled variables? Remember that controlled variables do not change from one group to the next.

5. Tyrone and his students grew frogs in water with different amounts of atrazine. How could you use this same approach in your experiment?

6. On the back of this page, draw the setup for your experiment. Add notes to help explain it.
Before You Read
Making Predictions
Now you know Tyrone’s question. How do you think nature will answer it?

After You Read
Drawing Conclusions
Reread the quote from Isaac Asimov on page 39.

1. Why is “Hmmm . . . that’s funny . . .” the most exciting phrase to hear in science?

2. Why do few true scientists shout “I found it!”?

Evaluating and Synthesizing Information
1. What is the most likely reason why the cells of the lab-raised frogs were less developed than the cells of the wild-caught frogs?

2. If Tyrone were to repeat this experiment, what should he do?

3. What other variable, in addition to the amount of atrazine in the water, was not controlled in Tyrone’s experiment?

4. This experiment did not completely support Tyrone’s hypothesis. Was the experiment a waste of time? Explain your answer.
5. Why didn’t the results of this experiment shake Tyrone’s conviction that atrazine feminizes male frogs?

Responding to the Text
1. The frogs raised by the students were all killed so their internal organs could be examined. Do you think killing these frogs was justified? Explain your answer.

2. Atrazine seems to have some negative effects on male frogs. What else would you need to know before deciding whether this pesticide should be banned from use in the United States?

Checking Predictions
Review your prediction on page 18 of this study guide. Were you correct? How did nature answer Tyrone’s question?
After You Read

Summarizing

1. What did piercing his ears four times symbolize for Tyrone? Explain the reason for each piercing.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. Why might the price of cheap food include a pond without frogs?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Making Comparisons

1. Use the Venn diagram to show how leopard frogs and spadefoot toads are alike and different. (Be sure to read the note on page 53.)

leopard frogs

spadefoot toads
2. Why might spadefoot toads be more resistant to pesticides?

________________________________________________________________________

________________________________________________________________________

Evaluating and Synthesizing Information

1. Look at the photo on page 51. How was the tadpole on the right able to grow bigger? Why is that both a good and not-so-good thing?

________________________________________________________________________

________________________________________________________________________

2. Why is studying the effects of pesticides complicated?

________________________________________________________________________

________________________________________________________________________

3. Why is Tyrone now more concerned about the effects of a combination of pesticides rather than the effects of atrazine?

________________________________________________________________________

________________________________________________________________________

4. Why does atrazine in the water affect humans differently than it affects frogs?

________________________________________________________________________

________________________________________________________________________

5. How do we know that humans can absorb atrazine?

________________________________________________________________________

________________________________________________________________________
6. On page 51, why does Tyrone say, “Environmental health and human health are one and the same”?

7. What are the possible long-term benefits of Tyrone’s experiments?

Understanding Cause and Effect
Use what you have learned in this chapter to complete this cause-and-effect chain.

Making Connections
You are not a frog or a frog scientist, so how does the information in this book relate to your life?
Wrap-up

Analyzing the List of Resources

1. Look at the sources listed on pages 54–55 of *The Frog Scientist*. How do they help establish Tyrone Hayes as an expert on pesticides and frogs?

2. Would it be helpful for this book to list all of the sources that Tyrone consulted before and during this experiment? Explain your answer.

Discussing the Issues

1. Should scientists raise frogs to use in experiments? Should they collect frogs in the wild and use them? Give details to explain your answer.

2. In another study, Tyrone discovered that the growth of tadpoles was affected when their water contained contaminants 50 times lower than the level permitted in our drinking water. Should frogs be used as a low-cost way to detect contamination in our water sources? Why or why not?

3. Should the use of atrazine be banned in the United States, as it is in Europe? Why or why not?
Asking Questions
List at least three questions you have after reading this book. They might be related to frogs, frog scientists, college students, the use of pesticides, or the environment in general. Suggest how you might find the answer to each question.

1. ______________________________________________________________

2. ______________________________________________________________

3. ______________________________________________________________

Completing Your KWL Chart
Look back at the chart you started on page 5 of this guide. Now it’s time to complete the last section of it. Explain what you have learned about frogs from this book.

Making Connections
1. How has reading this book affected your opinions about the use of pesticides?

_________________________________________________________________

_________________________________________________________________

2. Has reading this book increased your interest in working in a scientific field when you are older? Explain your answer.

_________________________________________________________________

_________________________________________________________________

Economics Connection
Farming is a business. Farmers must be able to raise and sell enough food to make a profit, or they cannot buy seeds, tractors, and the other equipment they need to grow more food. They also cannot pay their workers or even buy water and electricity.

Working with a partner, imagine that you have a large farm where you grow corn, tomatoes, and other vegetables. Decide whether to use the pesticide atrazine to control weeds. Bear in mind that a study by Syngenta, producer of atrazine, shows that farmers who use this product harvest from 4.3 to 10.8 bushels more of a crop per acre. Also decide how you will know how much pesticide is enough—and how much is too harmful. Share your decisions with the other “farmers” in your class.
Library Applications

Choosing a Research Topic
“Frogs” is a very general topic to research, but “frogs and the environment” is a more specific topic. In the index on page 58, you will see even more specific topics that are discussed in this book. If you were to write a research report, which three topics from the index would you choose? Why?

1. 
2. 
3. 

Learning More about Your Own Community
How safe are the water you drink and the air you breathe? Go to www.epa.gov/ and find out.

Enter your zip code in the My Environment field on the left side of the EPA home page. You will be linked to information about your local air quality index, cancer risks, water contaminants, and other data. This site also identifies local industries that must report to the EPA.

Study the information here, do some research to understand the terms used if necessary, and report what you learned about your community to your class.

Understanding Different Viewpoints
What do farmers, including organic farmers, think about the use of pesticides? Perhaps you live in or near a farming community and can interview people who depend on the use of pesticides to make a living—or people who have decided not to use pesticides. Even if you live in a city, you can use the Internet to gather information from farmers’ points of view. In addition, many city dwellers manage to keep a small garden and must deal with weeds and other pests.

Remember, though, that one farmer or gardener does not represent all farmers and gardeners. You must interview a number of people or access many sites to
obtain a fair sampling of opinions. Even then, you cannot assume that all farmers or all gardeners agree with those opinions.

Here are possible questions to ask or research:

• Do you use herbicides or insecticides on your farm? Why or why not?

• For organic farmers/gardeners:
  ✔ How does the lack of use of pesticides affect your harvest?
  ✔ What other means do you use to control insects and weeds?
  ✔ How effective are these approaches? How practical are they, cost wise?
    Which ones would you recommend to others?

• For other farmers/gardeners:
  ✔ How does the use of pesticides affect your harvest?
  ✔ How much do you know about the effects of these pesticides on other living things, such as honeybees and frogs?
  ✔ Does rainwater from your fields run into a waterway? Has this water been tested for contaminants?

Find a way to share what you learn with others in your school and community. If you have a school or community garden, find out if insecticides are used on it. If so, perhaps you can convince the gardeners to try the more natural ways to control pests that you have discovered during your research.
Suggestions for Further Reading

Be sure to check pages 54-55 in The Frog Scientist for more resources!

Nonfiction books about frogs:


Nonfiction books about pesticides and the environment:


Language Arts Connection

Read one of the books above or another book on the same topic. Write a report that includes:

- A summary of the book
- The author’s main point
- A critique of the book (whether you agree with the author, whether the author's arguments were supported by current, credible research and logical reasoning, whether the author offered practical solutions to problems, etc.)
- A short biography of the author
## Correlations to National Standards
### For Grades 6–8

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