Thinking Like a

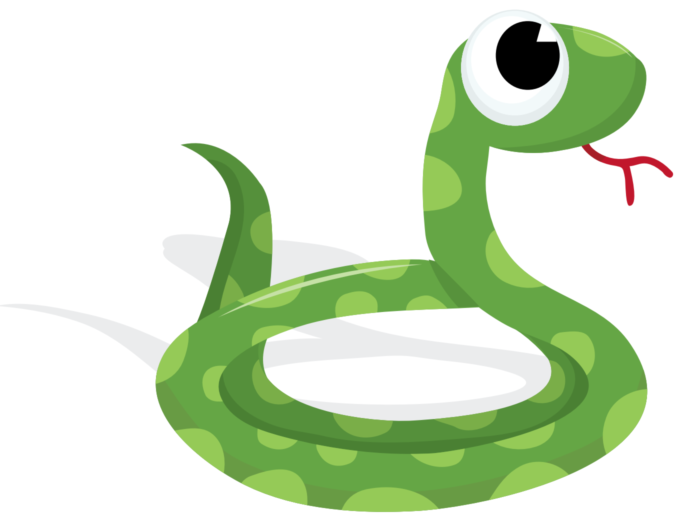
Fear of snakes inspires a unit on science as inquiry.

By Catherine Scott, Terry Tomasek, and Catherine E. Matthews

As supervisors of undergraduate elementary education majors, we are often in the classrooms of local elementary schools, watching science instruction take place. Recently, we were disappointed when a fifth-grade field trip to a river near the school was cancelled partially due to parents' fear of snakes. This fear of snakes developed into an opportunity to teach students about the processes of science: formulating questions, collecting and analyzing data, and communicating findings to the public. By using snakes to help students "think like a scientist," we engaged students in a five-day unit on inquiry while providing information about snakes found in our local community.

Developing an Inquiry Question

We introduced students to the idea that scientists develop research projects out of everyday experiences with the following example. We like snakes—and as a result, our neighbors and friends would often call us when they saw a "huge snake!" in their house or yard. Of course the "huge" snakes were almost always smaller than reported. This led us to wonder why people often embellish the size of snakes in their stories. We decided to do some research using the internet, books, and discussions with others to find out why people might exaggerate the size of snakes, explaining to the students that "learning stuff" is an important part of doing science. What we learned was that people often overestimate the size of snakes because of their fear of snakes. We wondered—does fear really cause someone to overestimate length? This led us to two inquiry questions: (1) How accurately do fifth-grade students estimate the length of snakes? and (2) What is the relationship between accuracy and how fifth graders feel about snakes? Our hypothesis was that fifth graders who are afraid of snakes will tend to overestimate their length.



Data Collection and Representation

We began our investigation by asking students to complete a data sheet in which they stated their attitude toward snakes and their previous experience with handling snakes. Next, students estimated the lengths of four "snakes"—some real, some models. Prior to our unit, students had estimated length and measured classroom objects as part of their math classes. In small groups, students observed the four snakes at four stations set up in the hall outside their classrooms: a rope painted like a snake, a rubber snake, a live snake in a cage, and a live snake that was hand-held by a teacher. All of the snakes (including the rope) were Honduran milk snakes. This is not a local species but is a common pet snake in the United States (The snakes were purchased from a local pet store and were "teacher's pets.")

Students estimated each snakes' length and its size (small, medium, or large) and guessed the species of the snake. As students waited their turns to write down their estimations, they also wrote down any questions that they had about snakes in general.

On the second day of our work with students, we reviewed the ideas of "wondering" and "learning stuff" as our scientific investigation began. We also discussed how we needed a way to analyze the data collected. The students were initially unsure of what to do with the information they had filled out on their data sheets.

They recognized that it would be necessary to know the actual length of each snake to compare it to the estimated length that they recorded on their data sheets. Students measured the rope snake and the rubber snake, and then we explained the different methods that scientists use to measure real snakes, including squeeze boxes, plastic tubes, and carefully stretching the snake. With both of our live snakes, we demonstrated using a squeeze box so that students could see how to measure a snake without causing any harm. Students were able to watch as the snake was pressed between a piece of foam and a sheet of Plexiglass, hence the term *squeeze box*. (The piece of foam was purchased from a craft supply store and the 18" × 18" Plexiglass was purchased from a hardware store.) As the snake lay motionless under the Plexiglass, a line was drawn on the Plexiglass along the snake's spine with a dry erase marker. After returning the snake to its container, we used a piece of string to trace the line on the Plexiglass and measured the string to determine the snake's length. The snake tube is a clear, plastic tube (purchased at a hardware store in the lighting section) that is slightly larger than the snake. The snake was put into the tube and the length of the snake was measured from tip to tail by marking the snake's length on the tube with a dry-erase marker. The line was then measured with a cloth measuring tape. For the stretching method, measurement marks are made on the floor against a wall. The snake is carefully lined up against the wall for measurement. In our experience, the squeeze box is the preferred measurement method for both accuracy and care of the snake. To practice with their own data collection, students worked in groups to estimate the length of a small rubber snake, then used a smaller squeeze box to measure the rubber snake and record their results. Students also recorded the error of their estimate—whether they overestimated, underestimated, or were accurate in estimating the length of the snake.

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Data Analysis

Now that we had the data from students as participants, we invited them to join us in analyzing the data. We revealed our original inquiry questions: (1) How accurately do fifth-grade students estimate the length of snakes? and (2) What is the relationship between accuracy and how fifth graders feel about snakes? We also shared our hypothesis: Fifth graders who are afraid of snakes will tend to overestimate their length. Because of time limitations, we created circle and bar graphs for each separate class as well as for the entire fifth grade using a student-friendly graphing website created by the National Center for Education Statistics (see Internet Resources). Should time allow, students could graph their own data.

Students were encouraged to look at the graphs and relate the data to our hypothesis. We explained that while we could not prove a hypothesis true or false, we could state whether our data supported or did not support the hypothesis. We talked about the nature of scientific argumentation and how to use the evidence to support explanations. Students recognized that our hypothesis was supported when examining student attitudes and their accuracy of estimation. Students who had more favorable attitudes toward snakes were more likely to underestimate or accurately estimate measurements of the length of each snake, rather than overestimate lengths. The fifth graders were surprised by the wide range of estimates for the length of each of the snakes.

Figure 1.

Comparisons between the traditional scientific method and the inquiry model we presented to students.

"The Scientific Method"	Inquiry methods used in our snake investigation	Examples of these activities from our snake investigation
State the problem or purpose	• Observe - Wonder • Ask questions - Wonder	• Observe snakes (real and models) • Wonder about snakes • Ask questions about snakes
Formulate a hypothesis	• Learn stuff - Wonder • Design investigation - Wonder	• Read about snakes, ask other people questions about snakes, watch more snakes • Design a study about snakes
Plan and conduct the investigation	• Conduct investigation - Wonder • Collect data - Wonder • Make hypotheses related to data and wonderings	• Run your study and collect data
Analyze data	• Analyze data - Wonder	• Analyze your data
Make a conclusion	• Share conclusions - Wonder • Argue - Wonder	• Share your conclusions • Question your findings • Question others' findings • Wonder about snakes • Ask more questions about snakes

(*www.sciencebuddies.org/mentoring/project_scientific_method.shtml*)

Learning About Snakes

The next day was devoted to answering students' questions about snakes. We explained to students that we had to do a lot of reading to answer their questions, much like scientists do as they begin to wonder even more about a topic. Most often, students asked what species of snakes were the longest and the most venomous. Students were particularly concerned with the number of venomous snakes in our area and how to identify venomous snakes.

We discussed different methods for identifying snakes, including length, girth, color variations, and scale type. Students were shown our state's online herp atlas and online field guides (see Internet Resources) and used an online classification key to identify snakes found in our region. We encouraged students to use this key to identify snakes that they find outside while also using their estimation and observation skills to help them make the correct choices at each step in the key. We used a frozen copperhead as a demonstration of the online classification key, thus teaching the skill of using a classification key and also teaching students how to identify the only venomous snake commonly found in our area.

Students were given an opportunity to touch our pet snakes if they had signed parental permission slips. We reviewed safety rules about snakes first:

- DO wash hands both before and after handling reptiles. This prevents the transmission of disease and other contaminants to the snake from the handler, as well as the transmission of bacteria such as salmonella from the snake to the handler.
- DO be aware of the response of the snake to handling. Snakes demonstrate their agitation by tail whipping, musking, jerking their bodies, and tensing their muscles. If a snake gets anxious, return it to its habitat until a later time.
- DO support a snake's body with your hands. Encourage students to pet the snake away from its head—explain that their fingernails are much larger than a snake's eyes and can cause damage.
- DON'T handle a wild snake, particularly if you are unable to identify the species.
- DON'T make a student hold or touch a snake if they are uncomfortable doing so. Students should be seated when holding a snake.

Students draw a line on the Plexiglass along the rubber snake's spine.

You could also invite a local herpetologist or wildlife biologist to share their knowledge about local species of reptiles and amphibians. They could describe the important role that these animals play in a balanced ecosystem, dispel the myths commonly associated with these animals, and bring to light science-related career awareness for children. Contact local zoos, museums, nature centers, and organizations such as Partners for Amphibian and Reptile Conservation (see Internet Resources) or your state's herpetological society.

Parents also attended one of our sessions to learn about snakes found in the Piedmont of North Carolina, which to us indicated an interest in the community to learn more about snakes in the area—a positive sign after the cancellation of our field trip!

Student Investigations

Over the next two days, we asked students to think about what types of inquiry questions they might develop based on our explorations of snakes so far. It was important to us that students see that one does not necessarily need to have an inquiry question in mind before an investigation begins. Often, questions can change or be formulated while conducting an investigation!

We guided this discussion to help students understand the nature of investigable questions and appropriate treatment of animals in experimentation. Students worked in small groups to generate an idea that they wanted to test with the snakes. Each group presented their idea to the class, which then discussed the pros and cons of each investigation as a community of scientists. Ultimately, each class chose one inquiry question to explore with the snakes and developed an investigation to carry out the following day.

On the last day of our inquiry project, students reviewed all of the steps to inquiry as we presented it: "wondering," "learning stuff," writing an inquiry question, developing a hypothesis, planning and conducting an investigation, analyzing data, arguing, and communicating findings. See Figure 1 for a comparison of our steps to inquiry to what some people think of as the traditional steps of "the" scientific method (plus, examples of our work to address each step.) We reviewed the idea that these steps do not always go in a set order. We reflected on the past week and how in different points, we were always learning, asking more questions, and reflecting on data. The complex nature of investigation was demonstrated and modeled on the whiteboard (Figure 2). We also examined how student wonderings led them to the investigation they planned to conduct on the last day of our project.

Because each group had a different hypothesis, as well as a different plan to conduct their investigation, students recognized that science can be done successfully in a variety of ways. However, nearly every class chose to study some aspect of how snakes move. See Figure 3 for a description of some of the investigations (p. 42). The students were familiar with making a hypothesis through their previous preparations for the science fair. Students were challenged when defining how they would measure their variables (how does one measure a snake's reaction?), determining the best methods in which to collect and display data, and explaining the reasoning behind their hypotheses.

Figure 2.

Model of scientific inquiry.

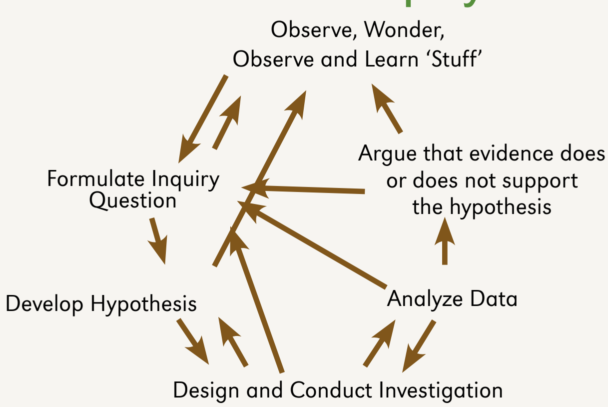

Figure 3.

Student-created investigations.

Research Question	Description
Can snakes move as easily on glass as on cardboard?	Students lined a box with either glass or cardboard and recorded the amount of time it took for the snake to move from one end of the box to another.
How will snakes react to different objects in the classroom?	While the snake was resting in a box, students presented the snake with a variety of items and recorded the snake's reaction.
Can snakes "run" an obstacle course?	Students designed obstacle courses inside cardboard boxes using paper towel holders, paper, and cardboard. Each group was given 60 seconds for the snake to "run" the obstacle course. We used a document camera to project images of the trial runs on the whiteboard so all students could watch.

Assessment

During this unit we assessed student understanding of science as inquiry through formative and summative methods as students collected, graphed, and analyzed data and created their own hypothesis and plan to test their ideas. We were also able to assess students' developing knowledge during oral discussions comparing reality and misconceptions related to snakes.

In all, this experience provided a meaningful learning opportunity for everyone. If snakes are not your passion (but do remember that children find them fascinating creatures) then you could start with any question that crosses your mind. For example, do children who are more active in our classroom (less able to sit still) consume more sugar (or less protein) for breakfast than children who can sit still? Is there a relationship between the electric bill of a home and whether the home has compact florescent lightbulbs or incandescent lightbulbs? Whatever your question, it is important to take your time and move through inquiry processes without rushing. Throughout the unit, students were able to recognize the human side of science, the "messiness" that is often left out of science textbooks and traditional laboratory activities in the elementary school. Students were engaged in authentic learning, examining data related to a topic of interest based on experiences in their community and school. As both participants in a research study and students developing their own investigations to conduct, the fifth graders were able to take on the role of the scientist and to think and reason scientifically. By making the methods of science inquiry accessible to our young students, we hope to enable them to recognize their capabilities and opportunities to explore science within their own community. We want them to keep thinking like ssssscientists! ■

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Internet Resources

Amphibians and Reptiles of North Carolina
www.herpsofnc.org
Carolina Herp Atlas
www.carolinaherpatlas.org
National Center for Education Statistics
http://nces.ed.gov/nceskids/createAgraph/default.aspx
Partners for Amphibian and Reptile Conservation
www.parcplace.org

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Content Standards

Grades 5–8

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Standard C: Life Science

- Populations and ecosystems
- Diversity and adaptations of organisms

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.