Inspiring Future Scientists

Comparing scientists' learning styles with their own taught fourth graders that they already have the "right stuff" to tackle careers in the sciences.

By Pat Betteley and Richard E. Lee Jr.

Sir Isaac Newton was notoriously antisocial. Albert Einstein dropped out of school, and Thomas Edison blew up a train car with one of his experiments. Twenty-five fourth-grade students began to wonder, "What *is* it with scientists? Does a person need to be crazy, a genius, or a geek to become one?" They found out for themselves in an integrated science/language arts/technology unit called "How Scientists Learn," in which they researched famous scientists from the past and cutting-edge modern-day scientists. Using biography trade books and the internet, students collected and recorded data on charts, summarized important information, and inferred meaning from text. Then they compared their own methods of learning with those of scientists past and present. The results? The students discovered that *anyone* can be a scientist!

Researching "how scientists learn" proved to be incredibly motivating to students and truly inspired them to consider science careers. The following is a description of their investigations during the six-day unit.

Engaging With Drama

On day one, in language arts class, Mrs. Abbey led a discussion about how people learn. She shared that she used to sit in a mulberry tree across from her house and read. Since she was hidden by the leaves and branches, nobody even knew she was there. If she got bored, she could check out what the neighbor kids were doing, watch the birds and squirrels, and munch on mulberries. The students shared their own techniques for listening to music, sitting in their favorite chairs, and lying with their dogs as they studied. Next, they completed a survey about how they preferred to study. (See NSTA Connection for a copy of the survey.) The surveys were set aside for future reference.

Next, the students learned about what it takes to be a scientist by reading and analyzing a skit based on the life of young John James Audubon. (See NSTA Connection for a copy of the skit.) Children were amazed to find out that young Audubon was not the greatest student and he much preferred being outside rather than inside—just like a few of them.

After assigning roles and reading through the skit, the class answered questions about Audubon from a Scientist Survey (Figure 1), and Mrs. Abbey recorded their answers on an overhead projector. They quickly realized that not every question had a literal answer. For example, the answer to the question, "What tools did your scientist use to study and record data?" was not explicitly stated. But by noting that Audubon kept journals, loved to draw, read his father's books, and spent hours observing nature, students could intuit that these were the tools he used to study.

Researching Past Scientists

The next day, students continued to learn about famous scientists' lives in language arts class by reading trade books. About 30 biographies were collected from the library for the students to use. These were prescreened to ensure they were well-written, accurate, and interesting. (For a bibliography of scientist biographies, see NSTA Connection.) Each student chose a scientist to research, looking for information about his/her child-

Figure 1.

Scientist's Study Survey.

Questions	Data
1. Why did he/she become famous?	
2. What was the scientist's favorite thing to do when he/she was young?	
3. What was his/her favorite thing to study?	
4. What kind of student was he/she in school? (Did he/she receive high grades? Did he/she like to learn at school?)	
5. What tools did he/she use to study and record data?	_____ reading books _____ doing things _____ using computer _____ writing/journaling _____ watching television _____ taking classes _____ other _____
6. Did the scientist collect anything when he/she was young?	
7. Was there a time when the scientist kept trying, even though he/she wanted to quit? If so, tell about it.	
8. Does the scientist give any advice to young people? If so, what is the advice?	
9. What surprised you about your scientist?	

hood and study preferences, which they recorded on a Scientist's Survey worksheet (Figure 1). One girl noted that Jane Goodall started observing animals as a toddler when she would lie down on the ground to watch an earthworm dig into the dirt. Another student found that Ben Franklin began inventing things when he was just a boy, designing wooden fins that strapped to his feet to speed his swim across a pond. Students were thoughtful and rather surprised that the scientists they researched had been fascinated by their surroundings as children and sometimes faced with obstacles, just as they were.

On the third day, Mrs. Abbey explained that everyone needs to know how to tell a fact from an opinion, whether he/she wants to be a scientist, a writer, or an athlete. She made the statement, "Mrs. Abbey is the most beautiful teacher in the school. True or false?" Students were tentative, not knowing what she was getting at, but many raised their hands to say that this was a true statement.

"How do you know? What facts support this?" asked Mrs. Abbey.

"She has pretty hair," volunteered one person.

"Her clothes are nice," said another.

A lively discussion followed about how a fact needed to be supported by data that could be measured or observed, whereas an opinion expressed someone's feelings that couldn't be observed. The students recognized that the concept of "fact or opinion" in language arts paralleled the same concept in science class. Earlier that week in science, the students had observed and measured gummy bears before and after they had been soaked in water. The science teacher wrote out 10 statements about the experiment. Students distinguished between statements such as, "the gummy bear looked fat," (opinion), or "the gummy bear was 2 cm wide" (fact). In language arts, Mrs. Abbey helped students connect the important process skill of distinguishing fact from opinion across the curriculum by having them create "flip-flap" books, folded booklets made up of six flaps that lifted to reveal answers underneath. A sentence describing the scientist was written on top of each flap. Underneath each flap, the students wrote whether this statement was a "fact" or "opinion." For example, one student wrote, "Marie Curie was the best scientist ever," on one flap. Underneath, she wrote the word "opinion" to denote that this statement was based on feeling rather than fact. Another flap contained the statement, "She was the first person to win two Nobel prizes." Underneath the flap, she wrote "fact," as this statement about Marie Curie could be observed. Once the booklets were completed, the students got into pairs and traded books so they could practice distinguishing fact from opinion using each others' books.

The teacher checked on success by monitoring the partners as they quizzed each other. She also collected the student flip-flap books and verified their accuracy on an individual basis. The students were remarkably accurate, picking up on key phrases that signaled a statement of opinion, such as "I think _____" and "_____ is the best."

Researching Modern Scientists

On day four, students researched modern, cutting-edge scientists in the instructional technology lab with technology teacher Mrs. Kehres. The task involved using the computer to complete a WebQuest called BioQuest (see Internet Resource), an online investigation in which students complete research using internet sites that have been preselected for them by the science teacher. The biographies in the BioQuest were purposefully written to include the specific information about scientists' childhoods for which the students were looking. Student research was completed within a one-hour computer lab time frame.

Figure 2.

Bio-poem format.

Fill in information about a scientist you've researched to create your own poem. Recopy the poem on different paper and illustrate.

Line 1: Scientist's first name _____
Line 2: Scientist who studies _____
Line 3: Three adjectives that describe the scientist
_____, _____,
_____
Line 4: Who works at _____
Line 5: Who learned by _____
Line 6: Who found that _____
Line 7: Who would like to see _____
Line 8: Last Name _____

Sample poem

Laurie
Scientist who studies monkeys,
Observant, creative, curious
Who works at an island off Puerto Rico and at Yale University,
Who learned by watching monkeys,
Who found that monkeys make the same mistakes we do,
Who would like to see kids do what they love, get involved,
and read
Santos

A list with each of the scientist's names and brief description from the BioQuest was posted, for example, "Yoky Matsuoka: Bioengineer Who Makes New Limbs." Groups of three students signed up in advance for the scientist they would research based on those descriptions.

Mrs. Kehres asked students whether scientists get information the same way today as they did many years ago. After some discussion, students decided to do what a good scientist always does—find out! The students worked in groups of three at a computer. Each child had a role in the group:

- The director read the BioQuest directions and information about the scientists aloud to the group.
- The researcher typed at the computer, clicked on links, and completed the quest.
- The recorder recorded the data about the scientist on the data table.

At the computers, the students proceeded to different links to read about their scientist's life and work. They recorded their data on their Scientists' Survey data tables and spent a productive class period in the computer lab researching.

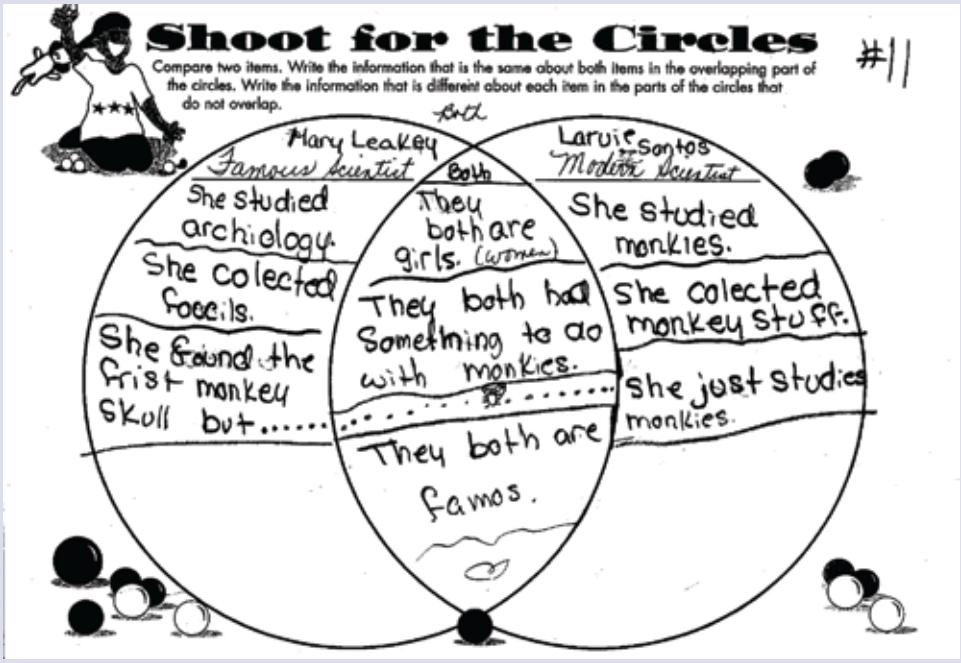
On the fifth day, back in the language arts classroom, students used the data gathered in the computer lab to create a "bio-poem," a poem about someone's life. The bio-poem activity helped students concisely summarize the highlights of a person's life. Summarizing is an important process skill in language arts, social studies, and science because it requires students to analyze information and then communicate their findings to others (also vital steps in scientific inquiry). A bio-poem has a set structure to guide the writing process. Once students returned from the computer lab with their data about scientists' lives, Mrs. Abbey showed them a sample bio-poem format and sample bio-poem about primate scientist Laurie Santos (Figure 2). She pointed out how the students could use information from Laurie's life to fill in the blanks in the sample bio-poem. Their assignment was to use the information gained from their research to infer, or come to a conclusion about, how to finish each line of the bio-poem format.

The bio-poem was used as an assessment to evaluate student understanding of the scientist's work. Student poems showed insight and deep understanding of their subjects. One girl commented on Mary Leakey's learning style in her poem:

Mary
Scientist who studies archaeology,
Curious, observant, and playful,
Who works in Africa,
Is a visual learner,
Who found the oldest monkey skull,
Who would like to see kids doing their best,
Leakey

Figure 3.

A sample Venn diagram.



Comparing Past and Present

By the sixth day of the unit, it was time to compare the investigation skills and interests of famous and modern scientists and draw some final conclusions. Students referred to their data tables and summarized information as they completed individual Venn diagrams (Figure 3). In the ensuing class discussion, students were surprised to find that scientists past and present shared many characteristics.

"They both loved to study animals," was one observation.

"They both used books for learning," noted another.

"But they weren't all the greatest students," added another. "Some didn't even finish school."

At this point, the teacher asked students how many of their scientists from the past had college educations. Some had little formal schooling, like John J. Audubon, who hated being indoors and failed his coursework, and Thomas Edison, who had only three months of formal schooling. Others, like Sir Isaac Newton and Marie Curie, had extensive college training. The teacher then asked the students why children who lived on farms in the country couldn't come to school in the summer and fall. Quickly, the class concluded that, in the past, children were needed on the farm, and fewer had the money or time to go to college. When the students compared the educational expectations of yesterday to those of today, they realized that getting a college education used to be more difficult and less common.

Just Like Us

Students' fact/opinion flip-flap books and bio-poems were assessed using a rubric that focused on the quality of research information, the ability to follow directions to create a complete project, the written demonstration of an understanding of the scientist's purpose and work, and an appealing presentation with correct spelling and grammar.

In a culminating journal entry, students used the surveys they'd taken at the beginning of the unit for reference, and they wrote about how their own interests compared to those of the scientists. A common sentiment was echoed in the words of one girl who wrote, "She likes fossils and skeletons—just like me."

"He learned the same way as I do, by reading and taking classes," commented another. A few students noted that modern-day students use different tools to learn, however, like computers and televisions.

Overall, nearly all students were left with the idea that scientists throughout the ages have been curious people who are passionate about learning. The students felt that they, too, could follow their dreams and make a difference. One girl who had struggled with her school work in the past seemed to have a newfound confidence in her future. Her eyes sparkled as she shared with her teacher, "when I grow up, I want to be a scientist!"

Throughout the unit, students were genuinely interested and enthusiastic. Many went beyond the call of duty to collect additional data about their scientists from home and the library. It was gratifying to watch students stretch their thought processes beyond simply recording literal answers to inferring meaning from the words on the page. The favorite piece of the unit for students and teachers alike seemed to be researching modern scientists who are alive and working currently. When asked if they would be more likely to choose a career in science after completing this unit than they were before, every child in the class indicated that he/she would. They identified with the scientists' curiosity, interests, learning styles, flaws, and struggles. By the unit's end, students answered the question, "How do scientists learn?" with a resounding, "Just like we do!" ■

Connecting to the Standards

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

Content Standards

Grades K–4

Standard F: Science in Personal and Social Perspectives

- Types of resources

Standard G: History and Nature of Science

- Science as a human endeavor
- Nature of science
- History of science

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

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Internet Resource

BioQuest
http://questgarden.com/59/78/7/080115031514/

NSTA Connection

Download the surveys, play, bibliography, and other unit resources in the lesson plan posted at *www.nsta.org/sc0904.*