Lesson 8:
Science Pen Pals

OVERVIEW

Benjamin Franklin was a gifted intellectual and master innovator. Even so, he relied on a network of friends for support and feedback in all his scientific enterprises. Franklin regularly corresponded with colleagues both in Europe and in the colonies about his studies on electricity. In this way, he played an important role in advancing electrical science.

Franklin's friend Peter Collinson, for instance, read his letters aloud at meetings of the Royal Society in London. These letters, describing Franklin's theories and experiments, formed the basis of *Experiments and Observations on Electricity*, which Collinson published in 1751. The publication launched cross-Atlantic studies of electricity, as prominent European scientists adopted Franklin's theories and experiments, and won Franklin international fame. Years later, it was his scientific status that enabled Franklin to succeed as a diplomat in England and in France.

This lesson draws on Franklin's scientific career to teach students the importance of exchanging and publicizing scientific ideas.

OBJECTIVES

Students will:

- See Franklin as a leader and member of an influential group of scientists in the 18th century.
- Learn that scientists exchange ideas and learn from one another.
- Understand the collaborative nature of scientific study.
- Practice writing letters.
- Participate in a peer review activity.

TIME

This lesson and activity require one or two class periods, plus homework.

MATERIALS

- "Lightning Rod…Point of Invention" handout
- Composition paper
- Writing utensils

McREL STANDARDS

Science

Standard 11. Understands the nature of scientific knowledge

Language Arts

Standard 1. Uses general skills and strategies of the writing process
Standard 3. Uses grammatical and mechanical conventions in written compositions

LESSON AND ACTIVITY

1. Tell the class about Franklin's career as a scientist, stressing his correspondence with European scientists and his work on electricity.

2. Assign students to read the "Lightning Rod…Point of Invention" handout.

3. Writing
Ask students to pretend to be Franklin just after he performed his legendary experiment and to write letters describing the idea behind the kite and key phenomenon in their own words. Allow time for brainstorming and composing drafts.

4. Peer Review
Assign students partners to whom they should address their letters. In a peer review activity, pairs meet to exchange letters and feedback.

5. Revision
Students use their partner's ideas to improve on their theories or incorporate new experiments and complete final drafts of their letters as homework.

6. Students may present their letters to the class individually or with their partners.

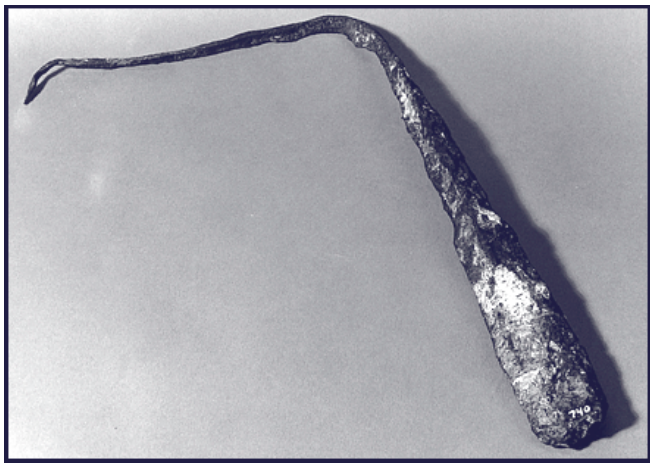
ASSESSMENT

Students are assessed on the extent to which their letters accurately, clearly, and creatively describe a theory and experiment of Franklin's and on how successfully they used the peer review process to improve their own and their partner's writing.

EXTENSION ACTIVITY

Separate students into pairs and ask them to write a dialogue between Franklin and his son, imagining how the two would have conversed during the kite and key experiment. Students may assume the roles of Franklin and his son in performing the dialogue before the class.

Lightning Rod...Point of Invention



What would you think if you saw a man chasing a thunder and lightning storm on horseback? You would probably wonder what on Earth he was trying to do. Well, if you lived in the 1700s and knew Benjamin Franklin, this is just what you might see during a terrible storm. Ben was fascinated by storms; he loved to study them. If he were alive today, we could probably add "storm-chaser" to his long list of titles.

It was in Boston, Massachusetts, in 1746 that Franklin first stumbled upon other scientists' electrical experiments. He quickly turned his home into a little laboratory, using machines made out of items he found around the house. During one experiment, Ben accidentally shocked himself. In one of his letters, he described the shock as "...a universal blow throughout my whole body from head to foot, which seemed within as well as without; after which the first thing I took notice of was a violent quick shaking of my body..." (He also had a feeling of numbness in his arms and the back of his neck that gradually wore off.)

Franklin spent the summer of 1747 conducting a series of groundbreaking experiments with electricity. He wrote down all of his results and ideas for future experiments in letters to Peter Collinson, a fellow scientist and friend in London who was interested in publishing his work. By July, Ben used the terms positive and negative (plus and minus) to describe electricity, instead of the previously used words "vitreous" and "resinous." Franklin described the concept of an electrical battery in a letter to Collinson in the spring of 1749, but he wasn't sure how it could be useful. Later the same year, he explained what he believed were similarities between electricity and lightning, such as the color of the light, its crooked direction, crackling noise, and other things. There were other scientists who believed that lightning was electricity, but Franklin was determined to find a method of proving it.

By 1750, in addition to wanting to prove that lightning was electricity, Franklin began to think about protecting people, buildings, and other structures from lightning. This grew into his idea for the lightning rod. Franklin described an iron rod about 8 or 10 feet long that was sharpened to a point at the end. He wrote, "the electrical fire would, I think, be drawn out of a cloud silently, before it could come near enough to strike..." Two years later, Franklin decided to try his own lightning experiment. Surprisingly, he never wrote letters about the legendary kite experiment; someone else wrote the only account 15 years after it took place.

In June of 1752, Franklin was in Philadelphia, waiting for the steeple on top of Christ Church to be completed for his experiment (the steeple would act as the "lightning rod"). He grew impatient, and decided that a kite would be able to get close to the storm clouds just as well. Ben needed to figure out what he would use to attract an electrical charge; he decided on a metal key, and attached it to the kite. Then he tied the kite string to an insulating silk ribbon for the knuckles of his hand. Even though this was a very dangerous experiment (you can see what our lightning rod at the top of the page looks like after getting struck), some people believe that Ben wasn't injured because he didn't conduct his test during the worst part of the storm. At the first sign of the key receiving an electrical charge from the air, Franklin knew that lightning was a form of electricity. His 21-year-old son William was the only witness to the event.

Lightning Rod...Point of Invention (continued)

Two years before the kite and key experiment, Ben had observed that a sharp iron needle would conduct electricity away from a charged metal sphere. He first theorized that lightning might be preventable by using an elevated iron rod connected to earth to empty static from a cloud. Franklin articulated these thoughts as he pondered the usefulness of a lightning rod:

"May not the knowledge of this power of points be of use to mankind, in preserving houses, churches, ships, etc., from the stroke of lightning, by directing us to fix, on the highest parts of those edifices, upright rods of iron made sharp as a needle...Would not these pointed rods probably draw the electrical fire silently out of a cloud before it came nigh enough to strike, and thereby secure us from that most sudden and terrible mischief!"

Franklin began to advocate lightning rods that had sharp points. His English colleagues favored blunt-tipped lightning rods, reasoning that sharp ones attracted lightning and increased the risk of strikes; they thought blunt rods were less likely to be struck. King George III had his palace equipped with a blunt lightning rod. When it came time to equip the colonies' buildings with lightning rods, the decision became a political statement. The favored pointed lightning rod expressed support for Franklin's theories of protecting public buildings and the rejection of theories supported by the King. The English thought this was just another way for the flourishing colonies to be disobedient to them.

Franklin's lightning rods could soon be found protecting many buildings and homes. The lightning rod constructed on the dome of the State House in Maryland was the largest "Franklin" lightning rod ever attached to a public or private building in Ben's lifetime. It was built in accord with his recommendations and has had only one recorded instance of lightning damage. The pointed lightning rod placed on the State House and other buildings became a symbol of the ingenuity and independence of a young, thriving nation, as well as the intellect and inventiveness of Benjamin Franklin.

"Lightning Rod…Point of Invention" is courtesy of "inQuiry Attic," The Franklin Institute Online. It is available online at http://fi.edu/qa99/attic3/.