SCIENTIFIC DISCOVERIES THE YEAR I WAS BORN

Students improve their scientific literacy by researching important discoveries from the past

Abour Cherif

I have successfully used a learning activity titled "The Year I Was Born" to motivate students to conduct historical research and present key scientific discoveries from their birth year. The activity promotes writing, helps students enhance their scientific literacy, and also improves their attitude toward the learning of science. As one student stated, the assignment helped her understand the value of creative thought in various types of scientific research and illustrated for her the development of scientific concepts. After describing the main activity, this article offers six alternative pedagogical approaches to using it in the classroom.

Scientific principles and natural laws aren't self evident. They must be discovered by active minds applying the methods and techniques of scientific research, including inquiry (Bronowski 1965; Dewey 1920). Scientists use three main approaches to learn about nature: discovery science (inductive reasoning), hypothesis-based science, and a combination of the two approaches.

But why is such systematic activity important for our students? According to Bedrossian (2010, p. 39), "Today's students take for granted the personal computers, MP3 players, cell phones, cars, airplanes, and trains, antibiotics, televisions," the availability of fruits and vegetables in grocery stores year-round, and other modern conveniences. In addition, they have no sense of what life was like before they were born.

> According to the National Science Education Standards, understanding both the history of science and its effect on personal and social perspectives gives students a foundation from which to build scientific knowledge and make informed decisions in their lives. (NRC 1996; cited in Bedrossian 2010, p. 40)

In "The Year I Was Born" learning activity, we ask students to research what significant scientific advances

happened in their year of birth and present them to the class. Students rank their years' discoveries according to importance and must justify their rankings. Each student then selects two discoveries of particular interest to explain in more detail. During the presentations, each student argues that the year he or she was born was the most significant in the history of science.

Students not only explain which important discoveries were made, by whom, and how but also point out how these discoveries affected the development of science, technology, and society. The activity lets teachers offer useful bits of science history without sounding like history teachers or diverting students from the main goals of their classes, whether in general science, biology, physics, chemistry, astronomy, geology, oceanography, nanotechnology, computer science, or others.

During the activity, students are asked to start their presentations with statements such as:

- The year I was born was the most significant year in the history of science.
- Let me tell you about the year I was born: What a year of scientific discoveries!
- I set out to discover what happened in science the year I was born, and I found amazing things.
- What great things happened in the year I was born!

During their presentations, students focus first on the events of their birth year. Then, while discussing the significance of the discoveries, they may cover events that happened before or after that year as well. Students thus create a timeline showing the development of a scientific idea or technology over time, from its precursors to its future development. For instance, my student Louis decided to present on Monsanto Company's "NewLeaf Potato," genetically engineered in 1995, his birth year. The potato is scientifically important because it contains the gene for Bt toxin, a natural pesticide that provides in-plant protection from natural predators. The potato traces its success to the 1970 discovery of restriction enzymes by W. A. Arber, who discovered the mechanism that allows bacteria to specifically cut DNA at certain sequences, and the 1972 successful achievement of recombinant DNA by Stanley Norman Cohen and Herbert Boyer. These breakthroughs allowed scientists to cut and copy specific recognition sites of DNA strands, making genetic engineering a reality. Because of these discoveries, Monsanto could create the genetically modified potato. Louis discussed how the potato has had lasting repercussions on genetically modified food as a whole.

Students are given three weeks to prepare their assignment. Then every student gets 5–10 minutes to present (5 minutes on the research and another 5 for open discussion and questions). Since, mostly likely, numerous students in class were born in the same year, students can work in groups on the project or choose different subject areas to research, such as technology, health, or space science.

Finally, each student selects two particular discoveries from his or her birth year and answers these questions about them:

- What if these two discoveries were not made when they were made? What would the applicable scientific area look like today?
- What subsequent advances would not have been possible, and why?
- What are some of the previous advances and discoveries that made these two chosen discoveries possible?

Finally, each student must come up with one or two critical-thinking questions based on the two special discoveries covered in the presentation. The instructor collects the questions and includes some of them in quizzes or exams.

At the end of the class, students vote on the most significant discoveries and the best presentations. These can then be submitted to the school radio station, website, newspaper, or newsletter, as appropriate.

Assessment

Students are assessed on how well they did the following:

1. Conducted their research.
2. Presented their research and made it personal and relevant.
3. Showed the significance of the discoveries for science, technology, and society.
4. Responded to the questions asked by their classmates after their presentations.
5. Answered the questions of "What if"?
6. Submitted good critical thinking questions for quizzes and exams.

For more on assessment, refer to Cherif et al. (2009, 2011) for useful tools and techniques that can be used to

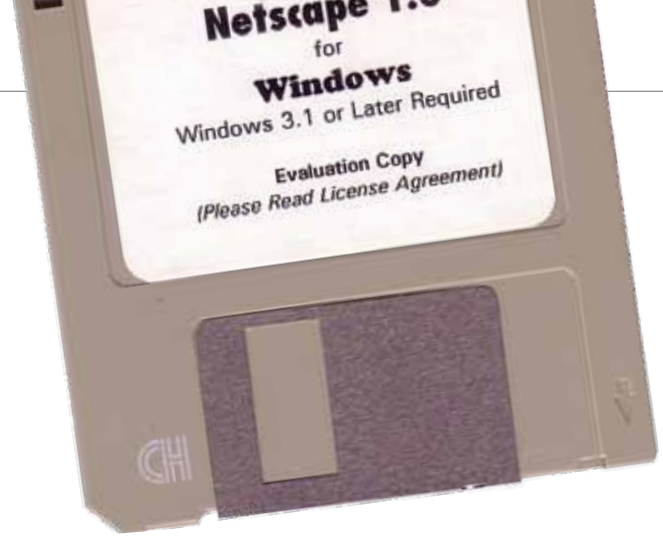
monitor the level of cognitive involvement of the students during the activity as well as to record the types of questions being asked by the students and the relevance of the questions to the subject matter.

Sample discovery list

I provide students the following list of scientific discoveries from my own life, as an example of "Look what happened the year I was born."

In the areas of science, technology, and medicine, 1953 was an exciting year with significant discoveries and events that have changed our world forever. They include:

- The structure of DNA was finally revealed by the American biochemist James Dewey Watson and the British physicist Francis Crick.
- Eugene Odum's important book, *Fundamentals of Ecology,* was first published and continued for ten years to be one of the most important books in ecology.
- Production of polyethylene, which led to development of isotactic polymers, was refined by the German chemist Karl Ziegler.
- The dynamics involved in plate tectonics were revealed by the American physicists Maurice Ewing and Bruce Charles Heezen. The Great Global Rift was finally discovered.
- *Strange particles,* or "strangeness," was proposed by the American Cal Tech physicist Murray Gell-Mann, where he introduced a quantum property that accounted for decay patterns of certain mesons. His explanation of the groups of hadrons that differed only in the nature of their electric charge proved useful in ordering the particles to form a classification chart.
- Successful use of the Heart-Lung Machine was pioneered by the American inventor John Heysham Gibbon.
- The year marked the first successful use by the general public of hearing aids small enough to fit into the ear opening.
- The first cheaply produced plastic valve mechanism for an aluminum spray can was patented by the American inventor Robert H. Abplanalp.
- The first significant experiment for replicating the early atmosphere of Earth and simulating Earth's early processes as potential for creating life was performed by the American graduate student Stanley Miller.
- The first 3-D movie released by a major Hollywood studio, *Man in the Dark,* premiered at the Globe Theater in New York City, beating *The House of Wax* to the screen by only two days.



- Edwin Powell Hubble, who overwhelmingly altered our understanding of the universe by demonstrating the existence of galaxies other than the Milky Way, died on September 28.

Teachers wanting a more detailed example of a "year I was born" report can download the author's (see "On the web").

Alternative approaches

Through the years, my colleagues and I have tried one or more of the following alternative pedagogical approaches for this activity.

- Historical research, written paper, and oral presentation with the focus on selected discoveries that took place in the year that a given student was born.
- Historical research, written paper, and presentation on the modern history of science with the focus on one area of science and starting with the year that a given student was born.
- Historical research, written article for the local newspaper, and presentation that reports on the most significant discoveries in science, medicine, and technology that took place in the year that a given student was born.
- Groups of three or four students with different birth years working together to write about the significance of the scientific discoveries of their birth years and demonstrating the influence of each of the discoveries on the other subsequent discoveries. For example, how the discoveries in 1996 in one area of biology influence the discoveries that took place in 1997, 1998, 1999, and or 2000 in the same area.
- Historical research, written paper, and presentation with the focus on selected discoveries and advancements that took place in the year that a given student was born and at any point in his or her life thereafter.
- Historical research, written paper, and presentation with the focus on selected discoveries and advancements that took place in a year of the student's choos-

ing. [Note: Although this option can be less engaging, since students do not use their own personal birth year, giving students free choice spreads out the years, leading to less duplication.]

Conclusion

It's amazing how students become excited about and proud of the discoveries in their birth year. Their excitement grows as they write their own versions of the modern history of science using their own birth year as the starting point. The biggest surprise for most students is how many discoveries took place every year in different areas of science, medicine, technology, and related fields. We've yet to find a birth year without numerous interesting discoveries that students uncover.

The students appreciate how the activity causes them to research and investigate the role scientific discoveries play in the advancement of science, medicine, and technology, as well as human life. In addition, students enjoy the activity, feel personal connection to the events they uncover, and become more engaged in a more active and dynamic class. Students start to refer to historical events and discoveries in class discussion, conversations with classmates, and in research papers and reports.

Most significantly, the exercise contributes to students' historical and scientific literacy. Students no longer see science as the fruits and the products of the knowledge tree but as the tree of knowledge itself (Derek S. de Solla Price, cited in Kaplan 2001). Such inspiring activities might help our nation start to regain the edge in science and innovation that Thomas Edison helped to create—the American way of innovation (Walsh 2010). As Swab (2010) has said in a different context, for students to place themselves in a historical period "takes some doing, but students can and will do so if they are lead by a skillful guide—an interested teacher" (p. 281). The activity is not limited to science. It can be conducted with students in all areas of knowledge. ■

Abour Cherif (acherif@devry.edu) *is a national associate dean of math, science, and clinical lab science curriculum at DeVry University home office in Downers Grove, Illinois.*

On the web

The author's own "year I was born" report: *www.nsta.org/highschool/connections.aspx*

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