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The Case for Learning History in Science Class: How Historical Context Shapes Scientific Discovery

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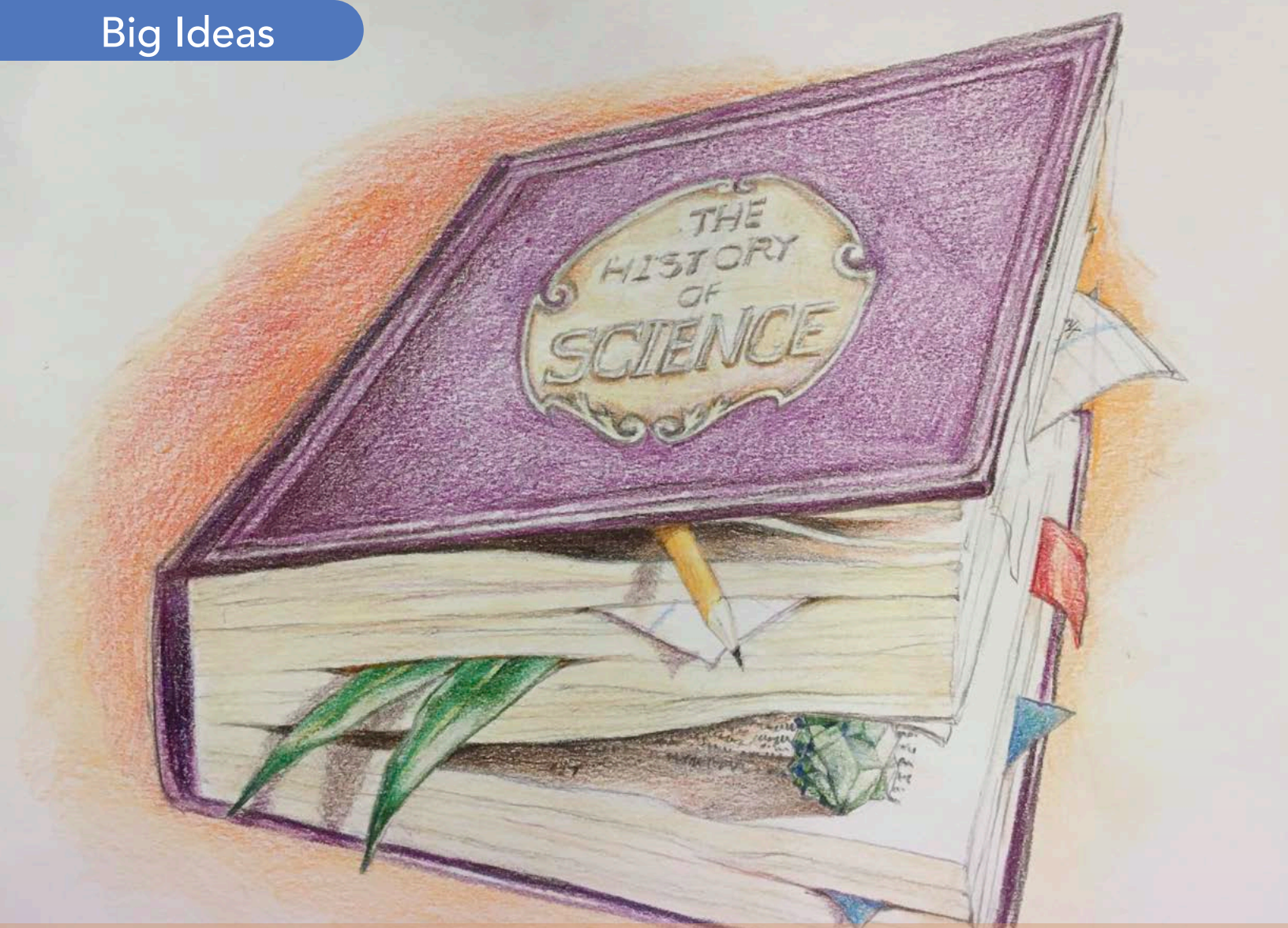

The Case for Learning History in Science Class

How Historical Context Shapes Scientific Discovery

Written by Mia Formato
Illustrated by Josephine Brane-Wright

Every science, technology, engineering, and math (STEM) student has a unique reason for studying science. An environmental engineering student may feel they need to help stop climate change. A nursing student may have a strong desire to help people. An astronomy major could have a lifelong passion for studying space and sci-fi. In college, many of us discover what we are most passionate about, what causes we want to fight for, or what problems we want to solve. Our undergraduate education sharpens our original reasons for going into STEM and into a purposeful future career.

This happens in college STEM courses which heavily emphasize the role of the individual in science. They bombard us with names of historical heavyweights: we all know Isaac Newton, for example. Chemistry majors will recognize the name Willard Gibbs. And any biology student could tell you who Reiji Okazaki was. Yet, rarely are we taught any scientific history beyond these names. Our classes stress the importance of these individual contributions to science, so as students learn the material, we also learn how to lead scientific investigations. We are taught that our own motivations for becoming scientists are paramount, second only to the discoveries we will one day make, the Nobel prizes we will win, the lives we will save, or the technology we will invent.

However, there is more to scientific history than just the scientists themselves. For example, consider penicillin, the first antibiotic. It is often remembered in tandem with the names of the men who discovered it: Alexander Fleming, Howard Florey, and

Ernst Boris Chain, among others. Fleming first identified penicillin in 1928 and Florey, Chain, and their team purified it in 1940. In 1945, these men collectively won a Nobel Prize for their work. By March of that same year, penicillin became available to the general public in the United States, and the rest of the world followed. This marked a monumental turning point in human history. The age of antibiotics had begun.

So why did the antibiotic age begin in 1945 when penicillin was discovered in 1928? One answer is that research takes time. Fleming was interested in studying the Penicillium molds that produced penicillin, which was how he made his discovery. Florey's team tackled the difficult task of purifying and testing its therapeutic capabilities. By 1940, their hard work paid off, and two years later, they cured streptococcal meningitis with an antibiotic for the very first time. The years spent developing penicillin is not unusual. Science is a waiting game. Experiments take time to devise, set up, and perfect.

But science is also a money game. Research of any kind requires funding. Florey's lab at the University of Oxford was only able to produce small amounts of pure penicillin. They could not mass-produce it on their own. Initially, the British government was uninterested in funding the project, so Florey's team turned to the United States. Through cooperation with the United States Department of Agriculture (USDA) and multiple American pharmaceutical companies, penicillin was finally mass-produced.

Yet truly understanding why events unfolded this way needs even more context, specifically World War II. If soldiers had not been dying in droves from battle wound infections, there would not have been the same urgency surrounding penicillin's mass production. Without the war, the American military-industrial complex that made such an effort possible so quickly would not have existed either. Penicillin still would have been discovered, purified, and shown to be effective, but without World War II, the arrival of the antibiotic age could have been delayed by decades.

Science doesn't depend on our personal contributions alone, or possibly at all, in the grand scheme of things. How it's perceived by societal institutions is much more important to determining what discoveries are made, make a difference, and make history.

It feels bizarre to associate war with science. Ask someone why we have antibiotics, and they might say, "because Alexander Fleming discovered penicillin in 1928," "penicillin was invented in 1945," or something along those lines. A less likely but arguably more well-rounded answer is because penicillin's discovery coincided with a world war, meaning governments and corporations around the world took special interest in making it widely available. Of course, penicillin's success still required the hard work and brilliance of Fleming, Florey, Chain, and the other Oxford scientists. Their dedication to their work and personal motivations are part of the story. But, like penicillin's origin is more than just the names on its Nobel prize, science in general is much bigger than just scientists.

Social circumstance continues to influence science. Take, for instance, the coronavirus disease 2019 (COVID-19) vaccine. Research into novel vaccines, coronaviruses, infectious disease spread, and other similar topics are now at the forefront of everyone's mind. Funding is also more accessible than ever. For example, Dr. Angelica Campos, a virologist at the University of São Paulo, studies how viruses like the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerge from bats in the Amazon rainforest. "It's extremely difficult to get funding for our kind of research," she said in an interview, "now during the pandemic, it has been a little easier. But as soon as the virus crisis is over, our financial worries will return." Like with the Oxford scientists, these researchers and their expertise are very important. However, superseding them are the institutions that determine science's role in society. It is these government agencies, corporations, and people leading them that ultimately decide what science is important and what research should get funded.

To prevent another pandemic, research like that of the University of São Paulo must continue to be supported after this temporary surge in interest. Unfortunately, that is not really under the control of the scientists. They also cannot control how their research is used once published, should it be used or even funded at all. These decisions are made by companies, politicians, and everyday people.

Scientists across all disciplines understand this aspect of their work, as it is a constant reality for them. They know it is important to understand the role their work plays in the bigger picture. For example, academic researchers must be able to articulate the precise argument needed to write successful grant proposals in order to get funding. But writing a stellar proposal does not guarantee a grant. Scientists cannot always rely on others to understand the importance of their work and support it like they do, not even those researching viral transmission in the middle of a viral pandemic. Unfortunately, too much depends on factors beyond their control.

Despite the instrumental role all of these factors play in scientific research, they are rarely discussed in undergraduate classes. Our undergraduate courses provide us with the knowledge we will tap for later discoveries to learn how to become scientists. However, they do not prepare us for what it is like to be a scientist. This may send us into our futures with a misunderstanding of what is important. Science does not depend on our personal contributions alone. How the research is perceived by societal institutions and the general public is much more important in determining what discoveries are made.

In order to understand who and what will shape our future as researchers, academics, engineers, doctors, technicians, pharmacologists, and more, we need to understand the importance of the science we do beyond ourselves. This knowledge comes with experience and time. But the seed can be planted by teaching students more about science's role in society. Learning scientific history along with scientific knowledge will raise a new generation of scientists who not only have talent, skills, and purpose, but thoughtfulness and perspective. As we amass centuries of knowledge of the natural world through our classes and professors, we can amass centuries of life experience by studying a bit of history too. • • •