



## Cautionary Tales: Ethics and Case Studies in Science

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**Ethical concerns are normally avoided in science classrooms in spite of the fact that many of our discoveries impinge directly on personal and societal values. We should not leave the ethical problems for another day, but deal with them using realistic case studies that challenge students at their ethical core. In this article we illustrate how case studies can be used to teach STEM students principles of ethics.**

### INTRODUCTION

Americans consider morality the most essential part of self (11).

This may be true of other cultures as well. All societies have elaborate rules of conduct that are often codified into law. Some of these imperatives seem hardwired. Human infants younger than a year and a half will look longer at visual displays showing violations of social rules (2). It is part of our primate heritage; individuals are punished if they stray far from acceptable behavior. Capuchin monkeys will reject a reward if they think they are being treated unfairly; they have a clear sense of right and wrong which depends on the social situation (3). Aesop would agree—he penned many a story where animals behaved badly and paid the penalty.

If morality and ethics are so central to our beings, what are our responsibilities as STEM educators to pass along the standards of society? And if we accept this challenge, what is the best way to instruct our youthful comrades in their quest for knowledge? I argue in this article that we should accept this obligation and that case study teaching is an ideal way to deliver the message.

Case-study teaching has a long and honorable lineage (4). In academic circles we find it used 100 years ago in Harvard Law School. The instructor would bring in a true criminal or civil case that had been adjudicated and conduct a class discussion with future lawyers, asking them to justify the rationale for the final decision—challenging them every step of the way. This provided students a real-world problem as part of their training for a real world ahead. The method was soon adopted by the Harvard Business School and various schools across the country, where it is now the standard. Medical schools have their own version

of the method called Problem-Based Learning. Again the idea was to use real world problems to train physicians, but in this case students work in small groups to analyze patient problems and provide diagnoses. The idea of using similar strategies to teach basic sciences to undergraduates is largely due to the efforts of faculty at the University of Delaware and the National Center for Case Study Teaching in Science, where there are hundreds of cases now published <http://sciencecases.lib.buffalo.edu/cs/>.

Research has shown that minorities and women undergraduates respond well to cases (5, 8). Among this group, cases have been shown to increase students' understanding of science by encouraging them to make connections between science concepts and situations they may encounter in their lives (7). In addition, the case method promotes the internalization of learning and the development of analytical and decision-making skills, as well as proficiency in oral communication and teamwork (6). The method, moreover, is a flexible teaching tool. Cases can take many different forms and be taught in many different ways, ranging from the classical discussion method used in business and law schools, to the arguably strongest approaches, Problem-Based Learning and the Interrupted Case Method, with their emphasis on small-group, cooperative learning strategies (4).

The method seems ideal for teaching ethics to STEM students. We have plenty of precedents to guide us. We have legal ethics, business ethics, medical ethics, bioethics, geoethics, environmental ethics, teaching ethics, research ethics, engineering ethics, and so on. And, of course, there are religious ethics, with each faith describing canons of behavior not to be breached. Some of them are commonly held community values, such as “thou shalt not steal, lie, or cheat.” Others are more specific, such as the research tenet, “thou should replicate experiments.” While some of these “rules” are so entrenched that they are tantamount to absolutes, others are more fragile and malleable; they are subject to the changing moral landscape. Policies about smoking in public places have rapidly shifted (12). Decrees against interracial marriage, once

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laws of the land, are now anachronisms, as are statues against same-sex marriage (1, 10). Such shifts in the moral topography offer wonderful opportunities for case studies as they challenge students at their central core of beliefs. There are hundreds of these case studies now available for teachers in repositories such as the National Center for Case Study Teaching in Science (<http://sciencecases.lib.buffalo.edu>), where you can find moral dilemmas depicted in cases on evolution, genetic engineering, nutrition, euthanasia, cloning, and organic farming.

Case studies can be used to show students acceptable standards of behavior within a given profession—the do's and don'ts—and the disastrous consequences that can occur if the rules are not obeyed. We learn of breaches of research ethics such as fraud, plagiarism, and sloppy book-keeping that ruin careers. We come to know cautionary tales, like Dr. Andrew Wakefield, who misrepresented the medical histories of 12 patients and claimed that his research results showed that vaccinations caused autism. He was eventually discredited and Britain stripped him of his medical license. Unfortunately, this sensational allegation has resulted in thousands of people refusing to have their children vaccinated, with a subsequent striking rise in measles.

In the past, these stories were neglected in the STEM classroom. Questions of right or wrong belonged elsewhere—in the home, in a philosophy class, in a church or tabernacle. In the science classroom we learned how to make petroleum, shoot rockets, synthesize drugs, manipulate DNA, and clone animals, not whether we should do so. Then came the Second World War. The academic community ran squarely into two striking examples of the deep entanglement of science and ethics. Suddenly, there was a public debate about whether Truman's decision to drop the atom bomb on Japan with the loss of millions of lives was ethical. The sensational trials of generals and scientists implicated in the atrocities at the Nazi concentration camps came to light during the Nuremberg Trials and patient bills of rights were drafted. Today our IRB committees and other ethical bodies monitor our experimental protocols involving research into issues of genetic engineering, stem cell research, three-parent embryos, etc. So my argument is that we should not ignore these disputes in the science classroom; this is where the technology is coming from—the STEM laboratories and the people in charge.

This is especially true as scientists have gained technological expertise; we see more clearly than ever how science and technological decisions can wreak havoc in our lives. Think about science in the courtroom, the public policy decisions on health and insurance, the intrusion of listening devices and the tracking of our e-mails and phone calls, the science of warfare and the use of chemical weapons and drones, the use of chemical fertilizers and organic farming, and possible designer babies. Very little that we humans do is not filled with moral or ethical conundrums. No more should we eschew these quandaries

in our classrooms. When we discuss DNA genomes, we should not only speak of how the technology can be used to track potential criminals, but also how it can lead to social and personal dilemmas when we identify parentage, plot evolutionary lineages, discover genetically modified food, and detect mutations that might lead to lethal disease and the loss of insurance. How better to deal with such contentious matters than to use case studies? Case studies are stories with an educational message, and as such they are perfect vehicles to integrate science with societal and policy issues. They are ideal because of their interdisciplinary nature. They deal with real issues that students will face in the future. And people love stories.

## RESOURCES FOR ETHICS CASES

There are several STEM case repositories in the world; arguably the largest is the National Center for Case Study Teaching in Science, with over 500 case studies published over the past 25 years. Its greatest strength is in the fields of biology and health-related professions. Over 100 cases are catalogued as having ethical issues, ranging in suitability from middle school student classes to faculty seminars.

We seldom find pure instances of ethical transgressions, where issues of fraud, fabrication, or plagiarism are discussed. Rather, ethical issues are more apt to be a sidebar to the main thrust of a case concentrated on a health or environmental problem. And even in these cases, an individual may not be wrestling with problems involving societal standards. Instead, they grapple with whether it is prudent to make one decision versus another. It may be as simple as whether or not to have an operation or whether it is healthy to use drugs to lose weight.

Let me give you a flavor of the kinds of issues and cases that are available:

### Personal dilemma

Often such cases involve medical issues, as we see in "A Right to Her Genes" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=316&id=316](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=316&id=316)). In this true story, students examine the case of a woman, Michelle, with a family predisposition to cancer, who is considering genetic testing. The woman wishes to get some information to confirm this predisposition from a reluctant aunt so that she can better decide whether to remove her breasts and/or ovaries prophylactically. The aunt is illiterate and poor and had previously been estranged from the rest of the family. A genetic counselor is involved to help educate the aunt and hopefully obtain consent to get a DNA sample from her. Michelle must decide for herself what course of action she should take.

In "Spirituality and Health Care: A Request for Prayer" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=434&id=434](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=434&id=434)), a fourth-year medical student making hospital rounds with an attending physician is asked

by a family member of a patient to pray with her. The case allows medical students to explore issues related to patients' religious beliefs as they think through how they might respond to different expectations and requests they may receive from patients and their families in their professional career.

### Social ethics

These are cases where protagonists must decide how they will respond to evolving social standards. "SNPs and Snails and Puppy Dog Tails, and That's What People Are Made Of" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=337&id=337](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=337&id=337)) deals with questions of genome privacy. Students work together to research six lobbying groups' views in this area and then present their insights before a mock meeting of a U.S. House of Representatives Subcommittee voting on the Genetic Information Nondiscrimination Act. In working through the case, students learn about single nucleotide polymorphisms, common molecular biology techniques, and current legislation governing genome privacy.

"A Case of Cheating?" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=399&id=399](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=399&id=399)) involves two international students who are accused of cheating at the end of the semester, and the teacher must decide how to handle the accusation so that all students see that justice is done. The case raises cultural questions in the context of the use of peer evaluation and cooperative learning strategies.

### Medical ethics

Patient rights are a common concern in medical cases, whether they are the central issue of the case or a sidebar to teaching students about a particular disease syndrome. It is the central theme of the infamous "Bad Blood" case involving black men in Tuskegee, Alabama, in the 1920s ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=371&id=371](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=371&id=371)). They had contracted syphilis, and public health officials studying the progress of the debilitating disease originally did not have an effective treatment. Twenty years later, the antibiotic penicillin was discovered, yet treatment was withheld to maintain the integrity of the study, whose purpose was to follow the progression of the disease. The study was immediately stopped when this transgression was made public.

Often there are competing concerns, as when a person is confronted with a decision where their personal morality may be at odds with the decrees of a society or institution. "The Plan: Ethics and Physician Assisted Suicide" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=436&id=436](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=436&id=436)) is based on an article published in 1991 in the *New England Journal of Medicine* in which Dr. Timothy E. Quill described his care for a patient suffering from acute leukemia, including how he prescribed a lethal dose of barbiturates knowing that the woman intended

to commit suicide. As a consequence of the article's publication, a grand jury was convened to consider a charge of manslaughter against Dr. Quill. Students read the case and then, as part of a classroom-simulated trial, discuss physician-assisted suicide in terms of fundamental medical ethics principles.

### Research ethics

Courses in experimental design are frequently part of psychology curricula. They seldom are part of the typical undergraduate programs in other STEM fields, although there is an excellent resource in the text *Research Ethics* (9). Apparently, students in STEM disciplines are supposed to absorb the proper canons of behavior by observation and osmosis.

"A Rush to Judgment" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=250&id=250](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=250&id=250)) deals with a typical psychological experiment, where a faculty professor is inattentive to his student assistants, one of whom is misrepresenting the results of an experiment. Another student is confronted with a moral dilemma of whether to report this infraction at a potential cost to herself. Involved in the case is a consideration of proper research protocol when dealing with human participants: informed consent, freedom from harm, freedom from coercion, anonymity, and confidentiality. Students are referred to the American Psychological Association's Ethical Principles of Psychologists and Code of Conduct.

"How a Cancer Trial Ended in Betrayal" ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=233&id=233](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=233&id=233)) begins with a quote from a news item.

*Birmingham, Alabama*—After Bob Lange spent 8 weeks rubbing an experimental cream, BCX-34, from a prominent biotech company BioCryst on the fiery patches on his body, researchers at the University of Alabama at Birmingham told him the drug was defeating the killer inside him. He felt grateful. "I believed it," he recalls. "I actually thought I might be cured."

But it was a lie. The drug had no effect on Lange's rare and potentially fatal skin cancer. And the two key people testing the drug knew it. Lange and 21 other patients were victims of fraud—a scheme made possible by the close tie between the university and the state's most prominent biotech company.

—*The Baltimore Sun*, June 24, 2001

The authors of this fascinating case state that the learning objectives are to learn the basics of scientific research in a clinical trial; to learn the principles of the scientific method; and to consider the ethical issues involved in clinical trials. Ethical potholes litter the road when universities travel with businesses, and millions of dollars and fame are at stake.

## Socio-environmental ethics

Conflicting concerns are the norm when dealing with the environmental problems that beset our world. They not only involve scientific principles, but invariably policy and hurly burly politics as well.

“One Glass for Two People: A Case of Water Use Rights in the Eastern United States” ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=603&id=603](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=603&id=603)) focuses on the growing issue of water use. Approximately 1.3 million people in North and South Carolina depend on the Catawba-Wateree River for water and electricity. The river is also important for recreation and real estate development. To meet growing water demands, elected officials in Concord and Kannapolis, NC, petitioned their state government to approve an inter-basin transfer of 25 million gallons of water a day from the Catawba River. Other towns in North Carolina and South Carolina that are part of the Catawba-Wateree watershed fought this request for water transfer. For this exercise, students are divided into teams that take the role of different stakeholders trying to negotiate a settlement to this lawsuit. In the course of the debate, students address fundamental legal, ethical, and environmental questions about water use.

“Ecotourism: Who Benefits?” ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=359&id=359](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=359&id=359)) critically examines the costs and the benefits of visiting fragile, pristine, and relatively undisturbed natural areas. Although ecotourism has among its goals to provide funds for ecological conservation as well as economic benefit and empowerment to local communities, it can result in the exploitation of the natural resources (and communities) it seeks to protect. Students assess ecotourism in Costa Rica by considering the viewpoints of a displaced landowner, banana plantation worker, environmentalist, state official, U.S. trade representative, and national park employee.

## Legal ethics

“The Slippery Slope of Litigating Geologic Hazards” ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=385&id=385](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=385&id=385)) is based on a lawsuit brought against the County of Los Angeles by homeowners suing over damage to their homes in the wake of the Portuguese Bend Landslide. It teaches students principles of landslide movement while illustrating the difficulties involved with litigation resulting from natural hazards. Students first read a newspaper article based on the actual events and then receive details about the geologic setting and landslide characteristics. They are then asked to evaluate the possible causes of the disaster and the responsibilities involved.

“The Sad But True Case of Earl Washington: DNA Analysis and the Criminal Justice System” ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=725&id=725](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=725&id=725)) recounts how, in 1983, Earl Washington

“confessed” to a violent crime that he did not commit and was sentenced to death row. After spending 17 years in prison for something he did not do, Earl was released in 2001 after his innocence was proven through the use of modern DNA technology. The case guides students through the wrongful incarceration of Earl and explores the biological mechanisms behind DNA profiling and the ethical issues involved.

“Complexity in Conservation: The Legal and Ethical Case of a Bird-Eating Cat and its Human Killer” ([http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case\\_id=664&id=664](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=664&id=664)) presents the true story of a Texas man who killed a cat that was killing piping plovers, a type of endangered bird species, and was prosecuted for it. In Texas, it is a crime to kill an animal that “belongs to another,” and there was evidence that another person was feeding the cat, which otherwise appeared to be feral. Students engage in a role-playing activity as jurors; they discuss the case and collectively decide whether the cat killer should be acquitted or convicted. This role-playing coupled with follow-up discussions helps students examine and articulate their own views on a controversial environmental issue and gain a better understanding about the complex interdisciplinary nature of conservation science and practice.

## CONCLUSION

There are plenty of ethical issues in every science classroom to discuss; they are not in short supply. They are hovering around every scientific study that reaches the public eye. Pick any news item with science as its theme and there will be the central question that is often not spoken: should we be doing this research at all, not only because of its economic cost, but because of the social, environmental, or health costs? Surely this should be always a pivotal question in the minds of all citizens. It is sometimes asserted that scientific discovery cannot or should not be stopped—that all knowledge is good. But even if we accept that premise, it seems worthwhile to consider the consequences of our actions. Where else to start than in our classrooms?

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