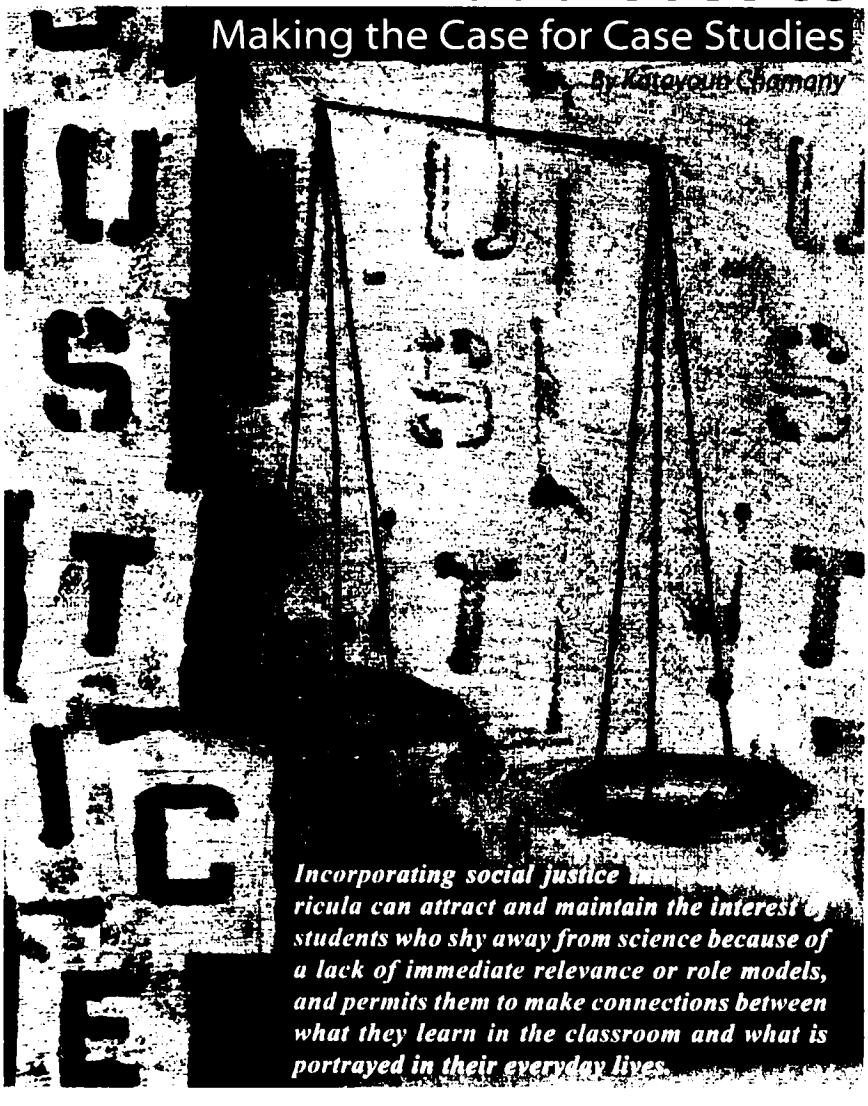
Science and Social Justice

Making the Case for Case Studies

By Katayoun Chamany



Incorporating social justice ... ricula can attract and maintain the interest ... students who shy away from science because of a lack of immediate relevance or role models, and permits them to make connections between what they learn in the classroom and what is portrayed in their everyday lives.

I joined the faculty of Eugene Lang College (ELC), the undergraduate division of The New School for Social Research, in 1997 because I found the mission of the college and the seminar approach to learning refreshing. This mission echoes that of the larger university in which the college is situated. The New School for Social Research was founded by academics interested in portraying a balanced view of social science with a specific emphasis on issues of equality and justice. Excited by the prospect of teaching in an environment with a long history of educational innovation, I set out to create a series of courses that would incorporate issues of race, class, and gender into the biology curriculum. Having taught only in traditional science departments designed to educate future biologists or medical professionals, the task of designing a program from scratch in this setting was a welcome challenge. Most of all, I looked forward to continuing my own education in areas that I hadn't been able to fully explore as a student. Connecting biology to cultural studies, urban policy, ethics, and political science lured me away from family, friends, and colleagues on the West Coast. Though my training as a yeast geneticist and cell biologist provided me with the disciplinary expertise to teach, my educational experience did not prepare me for the obstacles I would encounter.

On the first day of my very first class at ELC, halfway through the session two students stood up and thanked me for a lively and enthusiastic presentation of my research, announced that they were thoroughly disinterested, and walked out of the class. Stunned, I quickly realized that if I was going to successfully engage these socially minded students, I needed to make the biology meaningful, and from day one. To help me achieve this goal, my associate dean encouraged me to attend the Case Studies in Science summer workshop at the State University of New York at Buffalo, and it was there that I began to develop case studies in science that centered on issues of social justice.

Though many undergraduates accept that a basic understanding of science and math is essential in order to become a contributing member of society, they often can't articulate why. The relevance is lost on them, so they reluctantly register for science and math distribution requirements. Students at ELC present an added challenge because many of them have preconceived opinions about scientific research, seen through the critical lens of the social sciences, such as medical anthropology and cultural sociology. To attract and maintain the interest of this diverse student body, I not only had to make the study of biology meaningful, I had to speak to these criticisms directly.

Case studies and social justice issues

I decided to develop case studies that would help students view science through the eyes of scientists with humanitarian interests. I chose problems that would entice students to engage with the scientific material through exercises that required an evaluation of scientific research and its applications in a socially responsible manner. Because my students are coming to class

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aware of the ways in which medical and biological research have been co-opted to promote racial prejudices, the cases need to do two things: address the ethics of past abuses such as the Tuskegee Syphilis Trial and stereotypes stemming from the Social Darwinism movement; and demonstrate how science could be used as a tool to achieve social justice.

By tweaking existing case studies, I was able to make connections to present day concerns that instill in students a need to understand the scientific, and not just the ethical, dimensions of these stories. In one of my international health courses, I use the Tuskegee case as an important point of reference during an analysis of the standard of care debates surrounding clinical trials for HIV treatment of pregnant women (Bayer and Fairchild 1999). During the case analysis, students learn about the humanitarian efforts of Médecins Sans Frontières and Partners in Health, and read commentary and rebuttal by physicians and public health specialists that present arguments for, and against, adapting standards of care for particular communities (Wendler, Emanuel, and Lie 2004; Farber 2006). By delving deeply into these arguments, students also gain a deeper understanding of HIV transmission, the chemistry of antivirals, and the statistical analysis of double-blind trials. Another "found" case I use is Patricia Schneider's "The Genetics and Evolution of Human Skin Color," which focuses on classical inheritance and evolution (2005). Schneider has students read and then discuss Kate Chopin's short story, "Desiree's Baby," which illustrates the degree of racial tension and gender discrimination that occurred during the late 1800s in the South, in order to teach them about polygenetic inheritance. I have used pieces of this case to introduce the concepts of epistasis and natural selection, while my colleague, Alan McGowan, has expanded this topic into an entire course titled "Genes and Race" (McGowan 2005).

As I began developing my own cases, I tried to connect seemingly disparate areas of study to biology to ease my students into the science from a comfortable vantage point. The first case study I developed, Niños Desaparicedos, introduces students to the science behind DNA identification by exploring its application to the ramifications of Argentina's "Dirty War" of the 1970s (Chamany 2001). The case is based on the experience of 50 children who were displaced during that war and later reunited with their biological families through DNA analysis. Students consider not only the genetic evidence, but also the moral and emotional dimensions of these children's stories. The war captivates students interested in history and politics, and the case demonstrates that science can bring about social justice. Many of the linked resources are written in Spanish, some include artistic representations of the story, and all of the principal characters, including the scientist Mary Claire-King, are women. These aspects permit students to engage with the case from the perspective they find most interesting. But the underpinnings of DNA identification are steeped in the basics of meiosis and DNA mutation, and associated technologies such as RFLP mapping and DNA sequencing. Students need to grasp these basic biological principles if they are to understand how members of the military junta were arrested, and how the surviving children of the murdered parents were reunited with their grandmothers using mitochondrial DNA testing. By referring to a story with a rich political and cultural history, I am able to move students from the familiar to the unfamiliar, and by illustrating a purpose, I am able to make the science meaningful and tangible.

These are goals that have been promoted by a variety of reports concerned with improving the teaching of science in institutions of higher learning. The earliest that comes to mind is *The Liberal Art of Science: Agenda for Action*, published by the AAAS (1990). Similar recommendations were made in the Boyer Report in 1998, which emphasized the need for interdisciplinary learning followed by authentic assessments that measure communication and collaboration skills (Kenny 1998; Boyer Commission 2001). This approach, to learn science by doing and connecting to real-world problems, was central to John Dewey's philosophy of teaching, which has served as a cornerstone of the ELC curriculum since its inception. The Science, Technology, and Society (STS) Program at ELC aims to produce civically minded scientists and a citizenry capable of making informed decisions about scientific research and its applications. Faculty members in the program use global warming, environmental pollution, and sustainable energy as topics for case-based learning. While the STS program was established with the purpose of providing general education courses, we have had a number of students become interested in concentrating in the program and several have gone on to pursue graduate degrees in science education, environmental psychology, environmental policy, human rights and intellectual property law, medicine, and public health.

To prepare students for these future careers, the curriculum cannot simply "talk about the science," it must require students to engage in scientific problem solving and experimentation within a social context. Though our entire curriculum was designed with this goal in mind, research scientists at other liberal arts colleges have paired up with their colleagues in the social sciences to adapt specific courses to educate for social responsibility (Gilbert and Fausto-Sterling 2003). Scott Gilbert, author of *Developmental Biology*, has published a supplemental text, which juxtaposes advances in developmental biology and current issues in bioethics. The book is a product of student work from Swarthmore College and a version of the text is freely available at *www.devbio.com*. The philosophy behind the project is described in a companion article (Gilbert and Fausto-Sterling 2003).

At Whittier College, the science and society component has been extended to all students. Whittier's Science and Math in Context Program

requires every student to complete a tripartite sequence of courses that aims to place science and math in a cultural context. During the first two years of college, students complete one science course with lab, one mathematics course, and one interdisciplinary, case-based course. To ensure that the cultural component is well represented in this third course, faculty members from nonscience and math disciplines co-teach the course with the STEM faculty (Iimoto 2005). The program specifically aims to "illustrate the process by which scientific results are incorporated into public policy discussions at all levels of our society" by using real-world problems (see Resources).

Bioethicists and social scientists are also contributing cases that can be adapted by science educators. A rich collection of cases developed by the Genetics and Identity Group reminds us that DNA typing can be used to both include and exclude individuals from communities (see Resources). These cases demonstrate that genetic identity must be balanced with cultural identity if individuals are to maintain ownership of land, religious affiliations, and bonds of kinship. Cases developed by the Ethics Center for Engineering and Science at Case Western Reserve University and topics reviewed by the National Genome Research Institute demonstrate that the practice of science can benefit from partnership with the social sciences (see Resources). Dossiers from the Science and Development Network, which aim to provide reliable and authoritative information about science and technology for the developing world, include news articles, white papers, policy briefs, and opinion pieces that can serve as springboards for case studies with an international focus (see Resources). The broad range of topics includes indigenous knowledge, genomics, nanotechnology, climate change, biodiversity, and infectious diseases.

To use these resources most effectively, one must be convinced that the extra work is worth it. To remind myself of the need to place science in a social context, I often return to a tiny monograph published in 1990 by Sheila Tobias. *They're Not Dumb, They're Different: Stalking the Second Tier* reveals the frustration and alienation that students who are not naturally attracted to science feel in a typical college science course (Tobias 1990). These students were asked to journal their reflections about their course experiences, and I find the narratives sobering. Inspired to change this outcome, I eventually embarked on a curricular project that uses politically charged topics that matter to undergraduates and serve as vehicles for teaching basic scientific principles and methodologies of cell biology. This collection of curricular modules involves case studies and Problem-Based Learning and is titled *Cell Biology for Life* (CBL). The project at its completion will contain modules centered on advances in stem cell research, uses and abuses of botulinum toxin, and public health as it relates to HPV and cancer (Chamany 2005).

As I reflect on my journey, I should note that, at first, I was apprehensive to cast my net too broadly, believing that I did not have the expertise to teach about public policy, race relations, or gender issues. Like many other scientists, I believed that these perspectives were better taught by those in the social sciences. This sentiment was recently analyzed in a provocative commentary published in the journal *Cell* (Wolpe 2006). The author, Paul Root Wolpe, a bioethicist at the University of Pennsylvania, challenges scientists to lead discussions about the ethical dimensions of their work. He insists that ethics plays a central role in the scientific community, from conducting experiments, to sharing data and results, to considering the implications of scientific work.

Over time, I learned to become comfortable "grazing in other people's pastures," as Ken Bruffee so aptly wrote in *Collaborative Learning* (1993). The unsure footing I felt in the classroom when delving into these "nonscientific" areas was worth the level of student engagement I received. A second, unexpected outcome was that, by humbling myself in front of students, I was no longer viewed by them as the authority dispensing the "right" answers. As a consequence of that, the classroom dynamic shifted from an instructor-centered learning environment to a student-centered one, in which students took risks in their learning, overcame their vulnerabilities, and became more tolerant of diverse points of view. As an instructor, I also gained a greater understanding of cultural history, feminist perspectives, and media relations.

These interactions have led to the development of a protocol that I use in most classes. Below I outline some of the elements of this protocol.

Engagement: Social and political appetizers

I showcase the social and political perspectives of a case at the start of a module, unit, or class session. In my experience using popular forms of media is the quickest and most effective way to grab students' attention. I like to use video segments from news programs, film, or TV commercials that portray scientists conducting the research, those who oppose the research, and the potential recipients of future applications of the research. These video clips are short, but in just a few minutes they make the subject come alive and, because they involve real people, the science shifts from a faceless abstract concept to something that involves the passions and concerns of those involved.

Students in my classes come from diverse backgrounds and cultures, so I often follow a video clip with a structured discussion designed to capture a range of interests and promote discussion of diverse opinions. I assign a series of 10–20 short one-page articles from the secondary literature (newspapers, blogs, or science columns). Each article connects to the main topic using a specific angle. For example, when starting a unit on stem cell research, I might assign articles that review the ethics surrounding specific sources (cloning, egg donation, parthenogenesis), funding initiatives, local and

international legislation, and issues of access. The class is broken into small groups and each group assigned only 1 of the 20 articles. Each group learns only part of the story, and is asked to address three metacognitive questions: (1) What did you learn? (2) What did you find most fascinating/horrifying? (3) What remains unclear? Articles are assigned such that one group's unanswered questions will be addressed by another group. As reporting commences, the conversation shifts from one group to the next, and together, students construct the story of the case, which allows for multiple points of connection. Students interested in socioeconomic issues will be drawn to the subject because of the private-public debate concerning stem cell banks. Others will engage with the philosophical definitions of life or the stance that each religious group has pushed forward. Some groups will be surprised to learn of the unequal racial representation in current stem cell lines. Not all questions will be addressed, so the structured discussion can be viewed as the first step in an interrupted case study. Because students generated this set of unanswered questions, they have more ownership of their learning and also have a collective desire to address these questions by conducting research and engaging in more class discussions.

Exploration: Maintaining the connection

If I were to only introduce the social and political dimensions in a case study and then immediately turn to the hard sciences using primary literature and textbook readings, my students would feel duped. So, in the course of my career, I have extended the social and political dimensions of my case studies into other parts of my courses by using companion pieces, which might be text, interactive websites, or art exhibits. These companion pieces are central to the case and are not ancillary or supplemental. Some companion pieces consist of articles from journals such as the *Kennedy Institute of Ethics Journal*, the *Hastings Center Report*, *Developing World Bioethics*, or guidelines from national committees, professional societies, or research institutes. These articles provide information about how a particular scientific discovery influences public policy. Other companion pieces are excerpts from books written for the lay public that again reveal details about the motivations of the scientists conducting the work or those who might be most affected by the work. For courses in which scientific research articles are the focus, companion pieces take the shape of news articles, interviews, reviews, and commentaries and rebuttals. Collectively, these companion pieces help students place the research in a larger context, highlight the potential biases or implications of the work, and demonstrate how scientific knowledge is constructed through experimentation, interpretation, and dialogue.

Authentic assessments: Creating a need for deeper understanding

Without a concrete task or goal, few students will consider it necessary to learn the science behind these social justice cases. The all-too-familiar question of "Why do I need to know this?" is an important one and I have tried to answer it by asking students to complete projects that are exemplars of real-world activities. Most of the projects center on public policy debates surrounding public health initiatives or access to the resources and tools of basic scientific research. These might take the shape of a letter to a policy maker, a symposium representing various stakeholders' views on a proposition or bill, or a policy brief. To help students see why science and ethics must inform their decision, we review case studies from the past that did not take this approach and resulted in negative consequences.

Some cases highlight how policy was not shaped by science but rather by emotion or moral beliefs. President Bush's dismissal of Elizabeth Blackburn from the President's Council on Bioethics can serve as such an example, and her article "Reason as Our Guide" explains the need to have all members of society present in deliberating national policies on stem cell research (Blackburn and Rowley 2004). Other cases illustrate how science can inform policy, and how implementation of such policies benefits from the expertise of individuals from other disciplines. One such example is the National Sickle Cell Screening Act of 1972, which was widely promoted by the Black Panthers and publicized in churches and community centers that served the African American population. Most African Americans embraced the public health effort that was designed specifically to address a disease that occurred in higher frequency in this population. Scientifically, the sickle cell diagnostic, which was based on Linus Pauling's work on the solubility of hemoglobin, was heralded as a breakthrough in molecular medicine. But the implementation of the diagnostic in a voluntary mass screening initiative backfired, as many carriers of the sickle cell allele were unjustly fired from their jobs, rejected from schools, and marginalized by their communities (Culliton 1972). With no cure for sickle cell anemia, it was not at all clear what the screening program provided for the community hardest hit by it. Some students are shocked to learn that Pauling himself lobbied for legislation to identify sickle cell carriers with a tattoo on the forehead in an effort to eliminate sickle cell anemia through family planning (see *It's in the Blood!* in Resources). They are equally disturbed by the fact that African American employees at the Lawrence Berkeley National Laboratory were being screened annually for the sickle cell trait as recently as 1997 (Hawkins 1997). Students are shocked by the lab's motive and their ignorance; sickle cell anemia is a genetic disorder and a person's genetic makeup does not change from year to year.

Putting it all together—MDR-TB: A social justice case

One of the most recent cases I have developed is on multidrug-resistant tuberculosis (MDR-TB) (Chamany 2006). In this case, students consider

the implications of the Senate Immigration Bill as it relates to the 1.5 million farm workers who will be subjected to a medical exam that involves TB screening. Preserving health as a human right without subjecting a marginalized community to further discrimination requires students to understand the science behind TB diagnostics and current treatment protocols, as well as the political and social history behind TB outbreaks and the development of MDR-TB. I introduce the case by showing video clips of Debi French telling the story of how she contracted MDR-TB from a Vietnamese student in her Southern California high school. In these clips, Debi speaks very conversationally about her experience. Because our students are approximately the same age as Debi French and have all experienced high school, the clip resonates with them and transforms TB from the disease of "the other" to something very real and tangible.

Maintaining this theme, we continue to explore the science of TB with readings from *Pathologies of Power* by Paul Farmer, founder of Partners in Health, and interviews with Farmer from the *New York Times* (see Resources). In upper-level courses, students read the guidelines for controlling TB published by the American Thoracic Society, the Centers for Disease Control, and the Infectious Diseases Society of America (Taylor, Nolan, and Blumberg 2005). These companion pieces remind students of the complexity of real-world problems and the need to approach them from a multidisciplinary perspective that is sensitive to issues of discrimination and health as a human right. They also motivate students by supplying them with the bigger picture as they grapple with scientific readings from the primary scientific literature or textbooks. Several assessments are presented for this case study and include a debate on TB screening and treatment policies for recent immigrants, proposals designed to promote patient compliance of treatment protocols, and educational campaigns that specifically target the most vulnerable populations.

Long-range effects

For students who may not seek careers in science, cases that incorporate issues of social justice vividly illustrate that a basic understanding of science is important if they want to be socially responsible members of society. Instructors should be sensitive to a student's apprehension toward taking a strong stance on a policy issue. By building in dialogue and exploration, students can gain the benefit of a variety of viewpoints and ideas, and in the end, often come away feeling a bit more comfortable putting forth a concrete product, be it a proposal, a letter, or an educational pamphlet or website. To their surprise, students often learn sophisticated science along the way, which gives them the confidence to continue to be lifelong learners of science. One of the students who walked out of my class that first day teaching at ELC requested that I be his academic advisor, concentrated in STS and photography, graduated with a dual degree, and is presently a Fulbright Fellow in the Philippines. I continue to receive email messages and notifications of articles of interest, from this student and others, that relate to the case study topics from class. A sampling of student emails that demonstrate the effect that these science and social justice cases have on student attitude, learning, and career interests follow. The first two are from students who took my Biodiversity Achieved lab course in 2004 and 2005, and the third is from a student who completed my Cell Biology for Life curriculum in 2005.

I'd like you to know that I often reference the experience I had in your Biodiversity Achieved course. This past summer I worked on an experimental organic farm in New Hampshire to learn about sustainable agriculture... The media/public silence about GM foods is also something that's made me want to become a secondary school biology teacher. If people do not see how science is relevant to them, they will not think it's interesting, and will leave all the decisions to the so-called experts. I think this is one of many areas in which the people of the United States have a lot to learn and reclaim about the participatory nature of democracy.

My year at Monterey Peninsula College has been spectacular, and I even survived all of general chemistry... I still am really enjoying genetics and get butterflies in my stomach every time DNA or RNA is mentioned. My biology teacher has helped me get into an intern research position this summer at UCSC with Grant Hartzog, who works with your favorite...yeast! As much as I am enjoying Monterey, I miss your teaching and labs. I have to tell you that your class changed my life.

I did learn a tremendous amount about "science" and stem cells, and what's so funny is now on television I see the Merck commercials for HPV testing all the time, a little over a year since we studied it. Also I had a close friend of mine lose his sister to a stroke... I knew that stem cells could have helped repair some of her brain damage... I see both sides though. There is the religious, moral aspect, and I could understand how people could be against prolonging life, but on the flipside, 25-year-old law students should be given an option to repair their brain damage from an unexpected stroke...so by taking your class, in the manner that you presented materials to us, showing us all of the benefits and then showing us the different political debates. (Remember that project in class when we were split into groups representing different views on the issue?) So much more helpful, by the way, than just handing us a piece of paper that is written about a person's viewpoint... I would love to take another class with you. I miss science.

The template I have presented is a simple one. I use popular media and social justice topics to engage students in scientific principles and methodology, and maintain this backdrop by

using companion pieces throughout the case study, module, or course unit. This approach demonstrates how science can be used to promote social justice and how policy decisions can benefit from the involvement of individuals who appreciate the contributions and limitations of science in a postpositivist world. The learning is stimulated by authentic assessments that encourage students to remain engaged with science (for both majors and nonmajors) long after the course is complete.

For faculty interested in transforming their lecture halls into laboratories of active learning, I recommend the workshops, institutes, and model curricula that are widely distributed by The National Center for Case Study Teaching in Science site and the SENCER site (see Resources). These two clearinghouses strive to provide a centralized location for sharing the methodology and the curricular products of this transformation. ■

Resources

Dev Bio—*http://7e.devbio.com/about.php.*

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The Genetics and Identity Group—*www.bioethics.umn.edu/genetics_and_identity/case.html.*

It's in the Blood! A Documentary History of Linus Pauling, Hemoglobin, and Sickle Cell Anemia—*http://osulibrary.oregonstate.edu/specialcollections/coll/pauling/blood/index.html.*

National Center for Case Study Teaching in Science—*http://ublib.buffalo.edu/libraries/projects/cases/case.html.*

SENCER—*www.sencer.net.*

Science and Development Network—*www.scidev.net.*

Whittier College Science and Math in Context Program—*www.whittier.edu/science-math/default.htm.*

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