Introducing Students to Cases

By Peggy Brickman, Shawn Glynn, and Geoffrey Graybeal

Strategically introducing students to a controversial science case—before they read it, watch it, or listen to it—motivates them to learn from it and paves the way for successful discussion and debate. A strategic introduction also provides an opportunity for the instructor to demonstrate scientific reasoning and share guidelines for the discussion and debate. In this article, we describe and illustrate how instructors should introduce students to a controversial case and prepare them for debating issues related to it.

A *science case* is a narrative about a science topic with an intellectual dilemma that stimulates inquiry, reflection, critical thinking, and problem solving (Brickman 2006). Controversial topics also often involve a moral dilemma, which instructors can approach by means of a method called *intimate debate* (Herreid and DeRei 2007). This is a powerful tool for dealing with topics such as legalizing marijuana, federal funding for cloning research, euthanasia, or abandoning the Hubble space telescope. With this method, two pairs of students face off across a small table, arguing first one side and then the other. At the end of this debate, they must abandon their formal positions and try to come to a consensus as to what is a reasonable position on the topic being considered.

The success of the case method and intimate debate is influenced by the manner in which instructors introduce students to cases. Recently, one of our colleagues, while teaching an introductory biology class for nonscience majors, introduced students to a case in the following way:

"Well, that just about wraps up our class today. Thank goodness it's Friday, eh? On Monday we'll begin our next unit, so read Chapter four over the weekend. Also, read the associated case on our course website. Monday, we'll break into small groups and debate some issues related to the case."

Students are often introduced to cases in this way. The introductions that precede case reading (or listening or watching) are often quick and superficial, with little thought given to engaging students' motivation to learn from the cases and preparing students to debate issues related to the cases. This is unfortunate because strategically introducing students to cases is an integral part of using the case method successfully (Loucks-Horsley et al. 2003).

The following vignette illustrates one way that an experienced biology instructor introduced students to a controversial case and prepared them for intimate debate of the issues involved. Vignettes of this kind are called *science-teaching cases* by Herreid (see internet resources): They are pedagogical in nature and designed for instructors' professional development, as opposed to *science cases,* which are designed for students' intellectual and ethical development (Glynn et al. 2006). This teaching case provides new instructors with a helpful example and seasoned instructors with a stimulus for reflecting on how they typically prepare students for cases and debate.

A teaching case: Dr. Stone and stem cells

"On Monday, as you know, we'll be discussing stem cells," announces Dr. Karen Stone to her introductory biology class for nonscience majors. "There are three basic sources of stem cells," Dr. Stone continues. "There are embryonic stem cells, embryonic germ cells, and adult stem cells. Some of the basic characteristics of stem cells are that they are unspecialized, self-renewing, and pluripotent, which means they can divide and differentiate into many different cell types, such as those that make hemoglobin, send nerve signals, or pump blood."

"You've probably heard a lot about human embryonic stem cells and their potential to save lives," Dr. Stone says. "For example, read the headline and skim the related article displayed onscreen and note the efforts to develop treatments for diabetes and other diseases" (see article summary in Table 1). A few moments later, a student's hand shoots up.

"Yes, Jason?" Dr. Stone inquires. "You've heard a good bit about this in the news, I imagine."

"Yes, Dr. Stone, I have," Jason replies. "By harvesting human embryonic stem cells, aren't you killing a human life?"

Dr. Stone pauses for a few seconds. Given her past experience teaching this topic, she is prepared for a question such as this, but she wants to give all of her students a little time to reflect on it.

"Well, Jason," Dr. Stone replies, "the question you raise is a good one. It's

TABLE 1

Summary of Harvard Stem Cell Institute article.

- Approval granted for Harvard Stem Cell Institute researchers to attempt creation of disease-specific embryonic stem-cell lines.
- After more than two years of intensive ethical and scientific review, Harvard Stem Cell Institute (HSCI) researchers at Harvard and Children's Hospital Boston have been cleared to begin experiments using Somatic Cell Nuclear Transfer (SCNT) to create disease-specific stem-cell lines in an effort to develop treatments for a wide range of now-incurable conditions afflicting tens of millions of people.
- The work will be conducted by two groups headed by HSCI senior investigators: Douglas Melton, co-director of the Harvard Stem Cell Institute; Thomas Dudley Cabot, professor of natural science in Harvard's Faculty of Arts and Sciences (FAS); HSCI principal faculty member assistant professor Kevin Eggan of the FAS Department of Molecular and Cellular Biology; and Harvard Medical School associate professor George Daley of Children's Hospital Boston, who has already begun some of his experiments.
- Melton's work will focus on diabetes; Eggan will initially work with Melton on diabetes, and then plans to focus on neurodegenerative diseases, such as amyotrophic lateral sclerosis (ALS)—better known as Lou Gehrig's disease. Daley's group will focus on blood disorders. Daley was one of the principal scientists who in 2002 demonstrated in a mouse model the feasibility of using SCNT to treat immune deficiency.

Note: Summarized from the *Harvard University Gazette*, June 6, 2006. Available at *www.news.harvard.edu/gazette/daily/2006/06/06-stemcell.html*.

an ethical one, and one that is probably on the minds of many us in this class. I'm going to respond by asking everyone to read a science case this weekend, and on Monday we'll discuss it in small groups, keeping in mind Jason's question about human life. This case, "Andrea: The Death of a Diabetic" [see internet resources], is about a woman who tragically died of diabetes when she was 39 years old. At that time, there was no cure in sight for diabetes. There was simply no way to replace the insulin-producing cells of the pancreas."

"But things may be changing. As I indicated earlier, diabetes researchers are making progress on experimental treatments for using embryonic stem cells to replace the pancreatic cells that produce insulin. So, for Monday's class, please read the case of Andrea and the chapter on 'Stem Cells and Diabetes' from the National Institutes of Health website [see internet resources]. We'll use the technique of intimate debate that we've used with previous cases. When we debate, please keep in mind that in an academic environment we share opinions with mutual respect. Although our opinions may be diverse, they should be based on logic and accurate scientific knowledge."

"When you read the case," says Dr. Stone, "think about how diabetes could affect you or those you love. For example, imagine that you're a parent and your 12-year-old daughter has Type 1 diabetes—this is also called juvenile diabetes or insulin-dependent diabetes—it's an immune-system disorder. Your daughter's immune system is destroying the cells in her pancreas that produce insulin, a hormone needed to process glucose and produce energy. Without enough insulin, she'll die.

"So you give your daughter daily injections of insulin. You also prick her fingers to monitor her blood-sugar levels because if they're too low, life-threatening shock can occur, and if they're too high, flu-like symptoms leading to a coma could result. In time, complications from the diabetes could lead to kidney failure, eyesight problems, nerve damage, amputation, heart disease, or stroke."

"Now assume that research with human embryonic stem cells leads to a treatment that can cure your daughter of her debilitating disease. But, using embryonic stem cells requires the destruction of a blastocyst, which is an early-stage embryo that many people view as a human life. And some of them believe that no potential medical benefit can justify its destruction. What would you do if your daughter had diabetes? Would some of you like to share your initial thoughts?"

Maria raises her hand and says, "I'm a Christian and the Bible teaches that life is sacred. I think that the human soul develops before birth. Embryonic stem-cell research destroys human beings, or at least potential human beings."

"Thank you, Maria, for sharing that view" says Dr. Stone. "Taking stem cells from viable embryos does destroy the embryos, an act that some people equate with taking a human life."

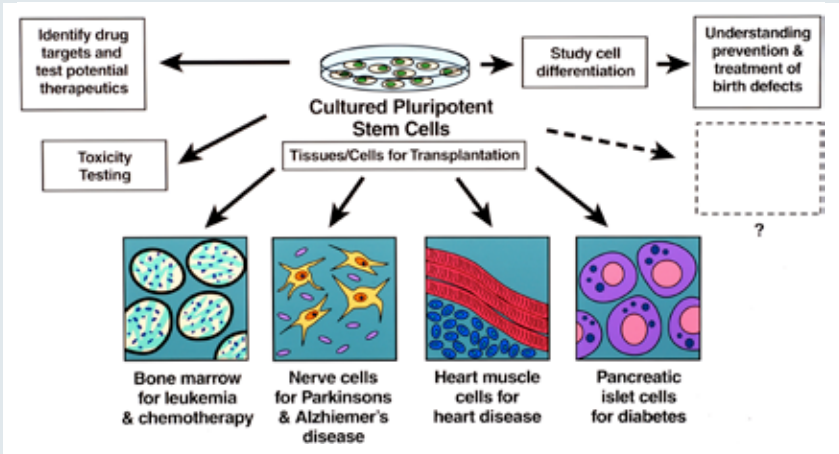
Seeing that Nick has raised his hand, Dr. Stone asks him for his thoughts. "I believe that life's sacred, but I also believe that God wants us to help those who are suffering from diseases," Nick says. "My older brother has diabetes. I think that stem-cell research will eventually cure diabetes, won't it, Dr. Stone?"

"Possibly, Nick. Stem cells could potentially serve as a source of replacement cells to treat diabetes, as well as Parkinson's, Alzheimer's, spinal-cord injury, stroke, burns, heart disease, and arthritis. Nick, your brother is one of about 16 million Americans who have some form of diabetes, and each year there are more than 30,000 new cases of Type 1 diabetes."

"Let's look at the National Insti-

FIGURE 1

The promise of stem cell-research.



Note: Image retrieved from *http://stemcells.nih.gov/info/media/defaultpage*. Bethesda, MD: National Institutes of Health, U.S. Department of Health and Human Services.

tutes of Health chart I'm now displaying on the screen in front (see Figure 1). In particular, notice the pancreatic islet cells for diabetes. The 'promise of stem cell research' that the chart refers to is the possibility that pancreatic islet cells can be grown from stem cells."

Hearing this and seeing the chart, another student, Maya, becomes so excited that she doesn't even think of raising her hand—she just blurts out, "That's the point, Dr. Stone! Embryonic stem-cell research has the potential to save and improve lives. There are probably millions of people who have health problems who could be helped by this research. Like, in situations where stem cells aren't creating lives, I think the cells should be used to help people. That should be the law. What do you think, Dr. Stone? What's your opinion?"

Dr. Stone expects the question Maya asks. It is a reasonable question, of course, and someone usually asks it when discussing embryonic stem cells. After pausing a moment to let the tension build and focus her students' attention, Dr. Stone answers, "As your science instructor, my role is to teach science, not my personal opinions about what should or should not be public policy. I want to remain objective and moderate our case debates fairly. I certainly don't wish to indoctrinate you or be perceived as indoctrinating you. There are other, more appropriate contexts for scientists to express their personal opinions. For example, on the screen in front, I'm now displaying an editorial from the *New England Journal of Medicine* in which the author argues strongly for federal funding of embryonic stem-cell research (see Table 2). He specifically argues that such research could cure diabetes, the disease discussed in the case we're reading this weekend. Editorials are very appropriate contexts for sharing personal opinions, as are debates."

"The bottom line is that your opinions are what matter here, not mine. My goal is for you to understand science well, so you'll be able to make informed moral and ethical judgments for yourselves. You'll all be sharing those judgments with each other in our next class, when you get together in small groups to discuss the case of Andrea and debate the pros and cons of stem-cell research."

"Before I continue," says Dr. Stone, "let me thank Jason for his

TABLE 2

Embryonic stem-cell research—The case for federal funding.

In the debate between those who support federal funding for embryonic stem-cell research and those who do not, a critical point has been overlooked. Research using this technology is strongly supported in a number of countries, including Australia, Israel, the Czech Republic, Singapore, Korea, and the United Kingdom. Others in the world appreciate the potential of this technology. If we continue to prevent federal funds from being used to support this research in the United States, the ability of our biomedical scientists to compete with other research teams throughout the world will be undermined. No matter how hard we try, we cannot legislate an end to a process of discovery that many in this country and elsewhere in the world consider ethically justifiable. The work will go on—but outside the United States.

The example of a single disease, diabetes, suggests the range of possibilities. Suppose that next week a group announced that it had successfully performed experiments showing that genetically identical pancreatic beta cells could be grown in tissue culture with use of a donor nucleus from a patient and human embryonic stem cells. If our working community of biomedical scientists had experience with this technology, it would probably take three to six months for the findings to be replicated; without the needed laboratory know-how, as a result of our current federal policy of permitting research with only a limited number of preexisting embryonic stem-cell lines, these experiments could take years to complete, and replication would be likely to happen outside the United States.

Note: Excerpt from an editorial by Drazen, J.M. 2004. *New England Journal of Medicine* 351 (17): 1789–90. Available at *http://content.nejm.org/cgi/content/full/351/17/1789*.

provocative question about stem-cell research and the beginning of human life. And let me thank Maya, Nick, and Maria for sharing their opinions with us. Your opinions reflect the importance of stem-cell research. You've connected this controversial topic to our lives, and you've motivated all of us to examine it closely. The better we understand stem-cell research, the better our opinions about it will be. Please keep one another's opinions in mind as you read the case about Andrea this weekend and prepare for our debate on Monday."

Motivating students to learn from cases

Teaching controversial science topics, particularly ones that are currently receiving strong media coverage, can be a challenge. It's understandable if an instructor, particularly a new instructor, might consider bypassing or minimizing coverage of such topics to avoid stirring up a hornet's nest in class. It's unquestionably safer to focus on less controversial topics such as protein production, the Krebs cycle, photosynthesis, mitosis, meiosis, and DNA structure. But that would be unfortunate because controversial topics such as stem cells have enormous potential to motivate students to learn science. Many students, particularly nonscience majors, don't realize how much science connects to their lives. Cases about controversial topics, and the intimate debate of these cases, can help make students aware of these important connections.

The combination of the case method and intimate debate can be very effective pedagogically, and the key to success with this combination is strategically introducing students to the case. That's what Dr. Stone did. She strategically introduced her students to a case, motivated them to learn from it by connecting it to their lives, and created a classroom environment in which her students—such as Jason, Maya, Nick, and Maria—felt comfortable asking questions, sharing opinions, and eventually debating issues. Dr. Stone presented her students with intellectual and ethical dilemmas to stimulate inquiry, reflection, critical thinking, problem solving, debate, and social awareness. The case method and intimate debate are becoming increasingly useful to science instructors because, as the number of scientific discoveries increases, so does the number of controversial topics (Herreid 2006). Examples of controversial biology topics for cases and intimate debate are in Table 3.

TABLE 3

Examples of controversial biology topics for cases and intimate debate.

Abortion	Drugs	Heredity
AIDS virus	Estrogen treatments	Nutritional supplements
Alternative medicine	Eugenics	Organ transplantation
Animal rights	Euthanasia	Organic foods
Biological weapons	Evolution	Pesticides
Birth control	Family planning	Pollution
Birth defects	Gender differences	Population growth
Bodybuilding	Gene therapy	Prenatal diagnosis
Circumcision	Genetic counseling	Recycling
Cloning	Genetic engineering	Silicon implants
Conjoined twins	Genetic screening	Species extinction
Cryonics	Global warming	Stem-cell research
Diets	Herbal remedies	Vitamins

Dr. Stone solicited her students' opinions and reminded them that, in an academic environment, different views—if informed, logical, and communicated in a respectful way—are welcome. After her students read the case of Andrea and information about stem-cell research, Dr. Stone followed the steps in the intimate debate technique described by Herreid and DeRei (2007). Essentially, her students faced off across small tables and systematically argued the pros and cons of stem-cell research. Then, they abandoned their formal positions and strived to reach reasonable positions on the issues. Finally, they gave brief oral reports of their deliberations and positions to the class. In reporting to the class, they identified the scientific principles and procedures that best applied to the issues, the ethics involved in them, and the implications for public health policy.

The guidelines that Dr. Stone used for introducing students to cases and facilitating students in their intimate debates are in Table 4. Consistent with these guidelines, she did not express her own moral opinions, although instructors' opinions are sometimes implicit in the cases they choose to share with their students. The moral opinions of science instructors, particularly instructors at public institutions, are being increasingly publicized and scrutinized. As a result, instructors should take great care when expressing opinions on sensitive public policy issues, such as abortion and genetic engineering.

Dr. Stone communicated complex scientific content to her students in an engaging way by using the case method and intimate debate, and she helped them to consider this content in the light of contemporary social issues and policies, thereby fostering their scientific literacy. She also used the case method and intimate debate to establish a classroom climate with the features recommended by the National Science Education Standards,

TABLE 4

Guidelines for introducing students to controversial cases and facilitating debates.

- Discuss the case from several perspectives. Sometimes students have narrow and rigid opinions because they have little substantial information, only the superficial information they have gleaned from TV and newspapers.
- Encourage students to express their opinions freely, but logically, with respect for others' opinions. Let students know that you value their opinions, as long as the opinions are based on scientific knowledge.
- Acknowledge that opinions, even when based on the same scientific knowledge, can be diverse. Explain that an informed debate and an open mind are important components of scientific inquiry.
- Discourage argument for the sake of argument. Explain that arguments made only for their shock value are unproductive.
- Moderate discussions fairly and establish rules for discussion. Do not censure, unless someone states scientifically inaccurate information or speaks to others disrespectfully.
- Make sure your students know that their course grades are not influenced by the personal opinions they happen to express. Let your students know that you hold each of them in high regard, and they shouldn't be concerned about expressing the "right" opinion to impress you.
- For the most part, try to keep your moral opinions to yourself so that your students perceive you as objective. Explain to students that your role as an instructor is to foster their understanding of scientific knowledge, not to indoctrinate them into adopting your opinions.

particularly the teaching standards B and E: "Teachers of science guide and facilitate learning" and "Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science teaching" (NRC 1996, p. 32; 45–46).

Conclusion

Students should be introduced strategically to a case prior to reading it, watching it, or listening to it. A strategic introduction captures students' attention, connects new knowledge to their existing knowledge, motivates students to learn from the case, and prepares the students for effective debates about issues related to the case. A strategic introduction also enables the instructor to demonstrate logical argumentation and share guidelines for properly debating the case. Instructors who introduce cases strategically help students to connect topics, particularly controversial ones, to their lives and develop informed opinions about those topics.

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Resources

Andrea: The Death of a Diabetic—*http://ublib.buffalo.edu/libraries/projects/cases/diabetic/diabetic.html*

Case Teaching Notes for "Andrea: The Death of a Diabetic"—*http://ublib.buffalo.edu/libraries/projects/cases/diabetic/diabetic_notes.html*

The National Center for Case Study Teaching in Science Case Collection—*http://ublib.buffalo.edu/libraries/projects/cases/ubcase.htm*

Pancreatic Islet Transplantation—*http://diabetes.niddk.nih.gov/dm/pubs/pancreaticislet*

Stem Cells and Diabetes—*http://stemcells.nih.gov/info/scireport/chapter7.asp*

The Promise of Stem Cells: Diabetes—*www.stemcell.umn.edu/stemcell/stemcell101/dzfacts/diabetes.html*

Peggy Brickman (brickman@uga.edu) *is an associate professor of plant biology,* ***Shawn Glynn*** (sglynn@uga.edu) *is a professor of educational psychology and science education, and* ***Geoffrey Graybeal*** (graybs@uga.edu) *is a science journalist with the PRISM project; all at the University of Georgia in Athens, Georgia.*