Using Case Studies to Teach Bioethics in the Science Classroom

The following article was written by Clark Wolf, Director of Bioethics at Iowa State University. The article was originally published in the September issue of “Bioethics in Brief,” a publication of the Office of Biotechnology.

It's a dangerous job, but it must be done, nonetheless. In teaching ethics, bioethics or science ethics to scientists, there are many hazards to be avoided – and many pitfalls to catch the unwary. Following are a few closely related dangers that face any teacher with the temerity to introduce ethics as a subject in the science classroom.

1) Appropriate and respectful representation of plural views where subject matter is controversial. Some ethical issues can be regarded as quite basic. For example, it is simply wrong to falsify data in order to advance a career in science. But in many contexts, the subject matter covered in an ethics class is controversial, and people may not agree even when they are all fully informed, earnest and thinking carefully and clearly. For example, people disagree about human genetic engineering. It is a mistake to present this disagreement as if one side of the debate were simply ignorant. Indeed, it is characteristic of the most interesting problems that there are intelligent and informed people on different sides. But as teachers, we typically come to bioethics problems with our own views and, to some extent, with our own agenda. The attendant danger is clear. Instead of presenting different views fairly, with appropriate representation for the reasons that lie behind each of them, unwary ethics teachers may be tempted to present their own views as if theirs were the only reasonable or rational view. This is a misrepresentation, and the result can be unfortunate for students. Students whose views are different from the views of their teacher may feel slighted and may justly feel that their values have been disparaged and misrepresented.

This problem is closely related to two others, discussed below. It is imperative that teachers respect their students' freedom of conscience, and that teachers should not simply use the classroom as an opportunity to proselytize.

2) Respect for students' freedom of conscience. In many contexts, students are not really at liberty to disagree with their teacher. A student can't claim that she or he doesn't accept the quadratic formula because it's not consistent with her culture or values. But where the subject of discussion is ethics, students have an important right to make their own decisions and to frame their beliefs in light of their own values and conscience. For example, in a class discussion of research involving human fetal stem cells, students should be encouraged to state their own views about the subject and to explain the reasons that support their view. Students can be required to understand the subject and can be held accountable for misrepresentation of the underlying science, for example. But those who have a clear understanding of the relevant issues must be free to form their own views, even if their views differ from those of the teacher.
3) **Proselytism.** These issues are closely related to another very serious danger. One way for ethics teaching to falter is for the teacher to use the class as an opportunity to proselytize or indoctrinate students. It is easy to see why some teachers fall prey to this temptation. We hold our own values dear. When we engage in discussion of ethical issues, we often hope to persuade others that our own views are the right ones.

4) **Anger, loss of control and chaos.** Finally, it is dangerous to introduce ethics in the classroom because people may be highly sensitive about ethical issues and may become angry when challenged. In the worst case, anger may flash in classroom discussion and it may be difficult for a teacher to maintain appropriate control of the class. Free-wheeling discussion can break down into chaos.

**What is a conscientious teacher to do?**

How can these dangers be avoided? The easy way to avoid them is to entirely avoid discussion of ethics and ethically controversial issues. This is an easy solution, but it is not a sophisticated one. Students need to learn how to argue for their own views and how to disagree in the context of a discussion without becoming angry or disagreeable.

In her recently completed Masters thesis, ISU bioethics student Sarah Heuer has persuasively argued that the case study method is an effective and appropriate way for teachers to address ethical issues in the classroom while avoiding the problems mentioned above. In the case studies she has developed, as in others that can be found on the ISU Bioethics Program Web site ([www.public.iastate.edu/~ethics/](http://www.public.iastate.edu/~ethics/)), students are assigned to read background material on a controversial ethical topic. Then they are asked to provide an articulate defense of a position that may or may not represent their own views and values. In order to do this, they must gain a fairly rich understanding of the problem under consideration and of the reasons that support one response to the problem. In the context of a moderated debate, students must represent the view to which they have been assigned and should be prepared to raise objections and formulate arguments relevant for the evaluation of alternative views.

For example, in her case study examining the Canadian court case “Monsanto vs. Schmeiser,” Heuer assigns one group of students to represent the position of Percy Schmeiser, the farmer who was sued by Monsanto Corp. for violation of their intellectual property (IP) rights. Schmeiser was accused of growing Monsanto's patented glyphosate resistant canola, without paying the required licensure fee. Other groups must represent Monsanto Corporation, another biotech company with an interest to maintain strong IP rights, and a group of organic farmers who are concerned that they may be held responsible for violating intellectual property rights if patented pollen blows on to their canola plants.

In the course of discussion, different views will be aired and different claims will be brought up in discussion. Ideally, students should gain (1) an understanding of different views and of the arguments that support them, (2) an articulate knowledge of the facts of the case and different parties' representation of those facts, and (3) experience making arguments and supporting claims in a context of friendly and open debate.

Where students have been assigned to defend a position, whether or not it is the one they hold, there are some additional advantages. First, students learn to evaluate arguments, and discussion is less likely to break down in angry chaos. Second, students may feel less self-conscious presenting or evaluating views when they need not represent them as their own.

Case studies don't solve all problems one might encounter when teaching ethics. There is still a risk that discussion may sometimes break down or that participants may still become angry when others raise objections. But even these risks are manageable if instructors adopt the role of moderator to help students through the exercise. The benefits of the exercise are crucial. Science students gain a great deal when they are introduced to issues in the ethics of scientific practice and when they learn to evaluate ethical aspects of new technologies.

The ISU collection of Bioethics Case Studies can be accessed online at [www.public.iastate.edu/~ethics/cs2.htm](http://www.public.iastate.edu/~ethics/cs2.htm).

Any opinions, findings, conclusions, or recommendations expressed in this article are those of the author and do not necessarily reflect the view of the ISU Office of Biotechnology or Iowa State University.

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### Educational Opportunities

**Summer 2009 Training Courses**

The dates and details for the summer 2009 biotechnology education workshop training courses offered by Iowa State's Biotechnology Outreach Education Center will be posted on the Web site at [www.biotech.iastate.edu](http://www.biotech.iastate.edu) in early 2009. Online registration for the summer workshop courses will be available at that time. For more information, please contact Mike Zeller or Lori Miller toll-free in Iowa at (800) 643-9504 or e-mail them at mzeller@iastate.edu or lorimill@iastate.edu.

**Project BIO Online Courses for Spring**

Project BIO online science-related courses will be offered for teachers and high school students for spring semester 2009. Project BIO is a partnership of biology educators and students at Iowa State University, Iowa community colleges,
high schools, and industries. Science-related courses offered for three credits during spring semester 2009 include:

- Biol 101 Introductory Biology
- Biol 155 Introduction to the Human Body
- Biol 173/Env S 173 Environmental Biology
- Biol 212 Principles of Biology II

For updated course offerings and more details, view the Project BIO Web site at http://project.bio.iastate.edu and follow the Online Courses link, or contact Dr. Tom Ingebritsen, phone (515) 294-9432, e-mail tsingebr@iastate.edu. Iowa high school students who want to take a course under the Postsecondary Enrollment Options Act will find details about this program at http://project.bio.iastate.edu/Courses/hsinfo.htm.

Howard Hughes Medical Institute Offers Live Webcasts Dec. 4-5 of Holiday Lectures on Science

The 2008 Holiday Lectures on Science presented by the Howard Hughes Medical Institute focus on “Making Your Mind: Molecules, Motion, and Memory.” The lectures will be webcast live on Thursday and Friday, December 4 and 5, from 9:00 to 11:30 a.m. CT. On-demand webcasts of the lectures will be available December 9.

The two lecturers are Eric R. Kandel, M.D., and Thomas M. Jessell, Ph.D., both investigators for the Howard Hughes Medical Institute at Columbia University. Kandel's research focuses on different forms of memory storage. Jessell explores how nerve cells in the developing spinal cord assemble and organize themselves to control sensory perception and motor actions. In a series of four lectures, the two researchers will discuss how the brain develops, is organized, controls behavior, and stores memory.

For more information and summaries of the lectures, visit the Howard Hughes Holiday Lectures Web site at www.hhmi.org/biointeractive.

Outreach News

Think Spring! Reserve Field Trip Times to the BOEC Now

If bringing your students to the Biotechnology Outreach Education Center (BOEC) in Ames is in your lesson plans for next spring, or you want the BOEC to visit your school or extension classroom, please make your reservations as early as possible. Spring is a busy time for the BOEC. To guarantee the dates you want, please contact Mike Zeller or Lori Miller at (800) 643-9504, toll-free in Iowa, as early as possible.

From Classroom to Career

February Getaway and April Career Conferences for Young Women

Getaway is a program to introduce female high school seniors to science, technology, engineering, and mathematics (STEM) majors at Iowa State University. At the Getaway event, scheduled for February 12-14, 2009, young women will spend two nights and one full day exploring the Iowa State campus, classes, and residence halls. They will attend regular classes, take part in tours, experience the dining halls, and meet women college students with STEM majors at Iowa State. The Getaway is sponsored by ISU's Program for Women in Science and Engineering. For application and registration forms, visit www.pwse.iastate.edu/getaway.html. Registrations are due by December 12. For more information, contact Trina Haverman, pwsegrad@iastate.edu or contact her at PWSE, 218 Carver Hall, Iowa State University, Ames, IA 50011-2060, phone (515) 294-7165.

Taking the Road Less Traveled is another program sponsored by ISU's Program for Women in Science and Engineering that helps Iowa young women in grades 6-12 to explore careers in science, technology, engineering, and math by interacting with women working in these areas. For grades 6-9, the spring conference dates are April 16 and 23, 2009. For grades 9-12, the spring conference date is April 9, 2009. Registration forms and details will be available on the PWSE Web site at www.pwse.iastate.edu/trlt.html. For more information, e-mail Carol Heaverlo at heaverlo@iastate.edu or contact her at PWSE, 218 Carver Hall, Iowa State University, Ames, IA 50011-2060, phone (515) 294-5883.

Watch www.biotech.iastate.edu in early 2009 for details about next summer's biotechnology training courses in Ames. Photo by Mike Zeller
Biotechnology Outreach Education Center

By Mike Zeller
BOEC Coordinator

November’s Iowa Biotech Educator is the second of four newsletters scheduled this school year. You can expect the other newsletters to follow in February and April 2009.

The holiday months tend to move quickly, so I encourage you to check your schedule for dates in late fall, winter, and early spring if you plan to use any of our education services. We are continually scheduling groups for visits to the Biotechnology Outreach Education Center (BOEC) or your classroom. Please plan as far ahead as possible.

BOEC in Action

Five schools, three Iowa State University programs for students, and four 4-H groups have scheduled visits to the BOEC so far this year. As I write this column, there are still BOEC dates available in December and most of January.

Along with school groups visiting the BOEC, I have been busy scheduling visits to schools and meetings throughout Iowa. This is our sixth year of promoting our ability to bring biotechnology to your classrooms. If you want to schedule a school visit, please plan for one whole day of activities. Some activities travel better than others or are best suited for certain grade levels. Their availability is dictated by the size and experience of the class.

For more information about classroom and event visits or field trips to the Iowa State campus, give Lori Miller or myself a call at the toll free number (800) 643-9504 or e-mail lorimill@iastate.edu or mzeller@iastate.edu.

BOEC State and National Conference Participation

October found me traveling to national and state science education conventions. Attending state, regional, and national science teacher conventions gives me an opportunity to gain new knowledge in the most recent science education trends, legislation, standards, and pedagogy. My goal is to gain new ideas, methods, techniques, and activities that I can share with you.

I attended and presented at the National Association of Biology Teachers (NABT) convention in Memphis, Tennessee, followed by our annual appearance at the Iowa Science Teachers Section (ISTS) of the Iowa Academy of Science at the Polk County Convention Center in Des Moines.

Once again, the ISTS conference confirmed why it is considered one of the premier state science education conferences in the nation. It was great to see many of our Iowa teaching colleagues and past workshop participants at our booth and at my presentations. It is always exciting to visit with teachers who are searching for ways to bring biotechnology into their classrooms.

BOEC Continues Training Pre-Service Teachers

For several years, the BOEC has been working with ISU’s academic colleges and departments to train their pre-service teachers in basic biotechnology techniques and principles so they can bring biotechnology into their future classrooms. This fall, more than 50 future teachers of biology, family and consumer sciences, and elementary education will receive 10-15 hours of classroom experience in biotechnology.

What’s Happening in 2009?

It is hard to imagine that we need to start talking about our 2009 summer workshop schedule now, but with our next edition of the Iowa Biotech Educator due out in February, it is a good time to write a reminder to yourself about the workshop registration this next spring. Final dates and registration information will be sent to you in the February issue of this newsletter.

Every couple of years, we add new activities and speakers to the workshop schedule. If it has been a few years since you have taken the workshop and feel you need a review, or if you are ready for the advanced workshop, please register this spring and encourage a colleague to attend. In January, more details about the 2009 summer workshops will be on our Web site at www.biotech.iastate.edu/ed_resources/Workshops.html.

I look forward to reporting to you again through this column in our February issue. Until then, have a productive semester and a great holiday season.
Lab Notes

Before You Leave for the Holidays...

Before you leave for the winter holidays next month, please take a few minutes to check your lab supplies. Thanks for your help, and have a safe and happy holiday season!

Please Recycle ISU Lab Supplies

Before leaving for the holidays, please recycle any free biotechnology lab supplies that you ordered from the ISU Office of Biotechnology this fall. The 10X TBE bottles, Carolina Blu DNA Stain, and unused pipette tips and boxes are refilled or reused for other teachers. To help keep costs down, please return these items to Lori Miller, Office of Biotechnology, 1210 Molecular Biology Building, Iowa State University, Ames IA 50011-3260. Please empty and rinse the 10X TBE bottles before returning.

Your Help Is Needed to Maintain DNA Fingerprinting Kit Supplies

Iowa educators who use the DNA fingerprinting kits that can be checked out from ISU Extension offices or Area Education Agencies around the state can help keep the contents up-to-date. The kits, provided by Iowa State's Office of Biotechnology, should have certain equipment and supplies in them at all times.

See the list at www.biotech.iastate.edu/publications/ed_resources/DNAFingerPrintKit.html to see what should be in the kit. If you checked out a kit this fall and found that an item was missing, please contact Lori Miller at the Office of Biotechnology, phone toll-free in Iowa (800) 643-9504, or e-mail lorimill@iastate.edu.

Safe Science Series

The National Science Education Leadership Association maintains a Web site of free science classroom safety articles by Dr. Ken Roy, Director of Science and Safety for the Glastonbury Public Schools in Glastonbury, Connecticut. Roy is an authorized OSHA instructor and is a member of the Board of Directors of the Laboratory Safety Workshop. He has authored 29 articles for the Safe Science Series located at www.nsela.org/publications/publications2.html, all of which can be downloaded as free PDF files. Recent article titles include:

- Storage Space: Anything but Empty
- Mold in the Laboratory
- Be Protected for a Safer Science Experience: Be Prepared!
- Having a Blast! Chemicals You Don’t Want to Invite to the Party!

NSTA Statement on Liability for Lab Safety

The National Science Teachers Association Board of Directors has adopted a revised position statement titled “Liability of Science Educators for Laboratory Safety.” The statement provides recommendations for science teachers, school district officials, and school boards. The revised position statement can be viewed at www.nsta.org/about/positions/liability.aspx. A list of all NSTA position statements is at www.nsta.org/about/positions.aspx#list.

Grants/Competitions

Ames Lab/ISU High School and Middle School Science Bowls on Jan. 31 and Feb. 20-21

The Annual Regional High School Science Bowl hosted by the U.S. Department of Energy’s Ames Laboratory and Iowa State University is scheduled for Saturday, January 31, 2009, at Iowa State in Ames. This is the 19th year of the high school competition. During the Regional High School Science Bowl, teams of four students, plus one alternate, answer questions from categories such as astronomy, biology, chemistry, mathematics, physics, and earth and general sciences. The regional winner competes in the Department of Energy’s National Science Bowl® in Washington, D.C., from April 30 to May 5, 2009. The 2008 champion of the Regional High School Science Bowl was Cedar Rapids-Marion Home School. Des Moines Central Academy was the runner-up, and West Des Moines Valley finished third.

The Annual Middle School Science Bowl for grades 6-8 will be Friday and Saturday, February 20-21, 2009, on the Iowa State University campus in Ames. Note that these dates are earlier than in past years. The event is hosted by the U.S. Department of Energy’s Ames Laboratory and Iowa State University. On Friday, student teams build and race hydrogen fuel-cell cars. On Saturday, participants will compete in a traditional science and math quiz bowl. The winning academic team of the 2009 competition will receive an all-expenses-paid trip to the National Middle School Science Bowl® in Washington, D.C., this spring to compete against other regional winners from around the country. Evans Middle School of Ottumwa won the 2008 Middle School Science Bowl. LeMars was second, and Council...
Bluffs St. Albert was third. Ogden won the hydrogen fuel-cell car competition.

For more information about the science bowls, visit www.ameslab.gov/education/sciencebowl/sciencebowl.html or contact Deb Samuelson at (515) 294-9557, debsam@ameslab.gov.

Grants, Awards, and Competitions

To find information about science-related scholarship competitions for students or educator award programs, visit the Office of Biotechnology's educational funding Web site at www.biotech.iastate.edu/publications/ed_resources/Ed_funding.html. The site has a brief description of each opportunity and links to more information.

If you know about other opportunities in science, family and consumer sciences, or agriculture that should be added to the Web site, please e-mail them to Glenda Webber, gwebber@iastate.edu.

Opportunities with winter deadlines include the following:

Toyota TAPESTRY
Deadline: January 21, 2009, 11:59 p.m. EST, submit application online

Toshiba/NSTA ExploraVision Awards
Deadline: Received by 5 p.m. EST, January 28, 2009

Outstanding Biology Teacher Award (National Association of Biology Teachers)
Deadline: Received by February 1, 2009

Biotech on the Internet

Office of Biotechnology Web Site
www.biotech.iastate.edu/

Educators who are looking for biotechnology lesson plans, background information, or interactive sites about basic biotechnology concepts are invited to explore the Web site established by the Office of Biotechnology at the address given above.

The menu option at the left titled Outreach Education will lead you to familiar resources such as equipment and supplies, summer workshop information, lab activities, step-by-step tutorials, curriculum units, the Iowa Biotech Educator and Bioethics in Brief newsletters, and contact information for biotechnology outreach education personnel Mike Zeller and Lori Miller.

The menu option titled Students leads to a publication about ISU majors that can prepare a person for a biotechnology-related career. There also is a link to a biotechnology research faculty directory that briefly describes the work of hundreds of researchers at Iowa State University who are using biotechnology in their careers.

Free Issue Papers Can Be Downloaded from CAST
www.cast-science.org/publications.asp

The Council for Agricultural Science and Technology (CAST) has made a number of biotechnology-related issue papers available to be downloaded free of charge. In these papers, educators can find a wealth of background information for their biotechnology units. The papers can be downloaded as print-quality PDF files at the CAST Web site. Free papers include the following and more:

• Vaccine Development Using Recombinant DNA Technology
• Implications of Gene Flow in the Scale-up and Commercial Use of Biotechnology-Derived Crops: Economic and Policy Considerations
• Avian Influenza Vaccination: A Commentary Focusing on H5N1 High Pathogenicity Avian Influenza
• Probiotics: Their Potential to Impact Human Health
• The Role of Transgenic Livestock in the Treatment of Human Disease
• Biotechnological Approaches to Manure Nutrient Management
• Safety of Meat, Milk, and Eggs from Animals Fed Crops Derived from Modern Biotechnology
• Avian Influenza: Human Pandemic Concerns
• Crop Biotechnology and the Future of Food: A Scientific Assessment
• Adventitious Presence: Inadvertent Commingling and Coexistence Among Farming Methods
• Metabolic Modifiers for Use in Animal Production
• Agricultural Ethics
• Animal Organ Donors: Human Health Applications
• Biotechnology in Animal Agriculture: An Overview
• Evaluation of the U.S. Regulatory Process for Crops Developed through Biotechnology
• Applications of Biotechnology to Crops: Benefits and Risks

The Gene Scene at American Museum of Natural History
www.amnh.org/ology/genetics

Through stories, games, interviews, and activities, The Gene Scene interactive Web site introduces the concept of genomics to students in grades 3 through 8. Students can read interviews with three young “Ologists” – kids who have an interest in genomics. The site includes a set of Ology cards, collectible online trading cards with images, and fun facts about genomics.

Activities for students to do away from the computer include creating a beaded bracelet that looks like the genetic code of an animal and a nature/nurture quiz on whether a trait is due to heredity or upbringing. Other activities cover topics such as cloning, junk DNA, and the Human Genome Project. After students explore the site, they can test their knowledge with a quiz from the section called What Do You Know?

The Gene Scene interactive Web site is a production of the National Center for Science Literacy, Education, and Technology of the American Museum of Natural History.

Print-and-Go Genetic Activities
http://learn.genetics.utah.edu/

For Print-and-Go genetic activities for intermediary grades through high school, check out the Web site of the Genetic Science Learning Center at the University of Utah at http://learn.genetics.utah.edu/. To access the Print-and-Go activities and other educational resources, teachers need to click on the Teach.Genetics box at the upper right.

More than 60 science and bioethics Print-and-Go activities are indexed under 10 general categories. The index includes a brief description of each activity. When educators click on an activity's title in the index to download the activity, a window appears that provides a description of the activity, the prior knowledge students need, the prep and class time required, and the PDF file to download. The 10 general categories include:

• Cloning
• DNA to Protein
• Gene Therapy: Molecular Bandage?
• Heredity and Traits
• The New Science of Addiction: Genetics and the Brain
• Newborn Genetic Screening
• Personalized Medicine: Drugs Designed for You
• Stem Cells
• Tour of the Basics
• Using Family History to Improve Your Health

Engage: Stem Cells
http://stemcellnetwork.ca/engage.php

Our neighbors to the north in Canada have developed a high school teaching resource on stem cell research called Engage: Stem Cells. The Web site has downloadable copies of resource materials on topics such as developing stem cell legislation.

Although geared to Canada, educators in the United States may find materials that they want to adapt for their classes. A glossary of scientific terms related to stem cell research and a timeline of stem cell developments around the world are featured on the site. Engage: Stem Cells was developed through the Ontario Genomics Institute by Genome Canada and the Joint Centre for Bioethics at the University of Toronto in collaboration with teachers and students.

Activities from Ag in the Classroom
www.agclassroom.org/scienceinshopping.htm

The Ag in the Classroom program, coordinated by the United States Department of Agriculture, offers a number of biotechnology resources for teachers. A lesson plan on high tech food is an overview for grades 7-9 of genetically engineered foods. A multimedia computer presentation about understanding biotechnology can be downloaded in Mac or Windows formats. Other resources include a PDF file of a pamphlet from Cornell University titled “Agricultural Biotechnology Questions and Answers” and a link to Agricultural Research Magazine.

Tips for Teachers

Have a Teaching Tip to Share?

The Biotechnology Outreach Education Center at Iowa State helps Iowa educators share their teaching tips on biotechnology education. Easier ways to do lab protocols, a new classroom demonstration that relates to biotechnology, or information about new materials and services for biotech educators are only a few examples of teaching tips. You can share your tips with Mike Zeller or Lori Miller by phoning toll-free in Iowa (800) 643-9504 or e-mailing them to mzeller@iastate.edu or lorimill@iastate.edu. With your permission, we will share your tip with other biotech educators in a future issue of this newsletter.
About the ISU Public Education Program in Biotechnology... 

Iowa State University's Public Education Program in Biotechnology is supported by ISU Extension; Ajinomoto Food Ingredients, LLC/Ajinomoto Heartland, LLC; Bayer CropScience; Cargill; Genencor International, Inc.; Golden Harvest Research; Growmark; The Greater Cedar Rapids Foundation–Diamond V Mills Donor-Advised Fund; the Iowa Biotechnology Association; the Iowa Farm Bureau Federation Agricultural Foundation; the Iowa Soybean Promotion Board; Kemin Americas; MBS Genetics, LLC; Pioneer Hi-Bred International, Inc.; the Roy J. Carver Charitable Trust; Syngenta Seeds, Inc.; West Central Cooperative; and private individuals.

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