**Integrating ethics into a chemistry-based environmental science course**
**Dan Higgins, KSU**

## SUMMARY

A chemistry professor incorporates ethics in a non-majors environmental science course to provide students with a framework in which they can evaluate environmental ethics dilemmas they are likely to face in their everyday lives.

## BACKGROUND

I teach Chemistry 315, Environmental Science: A Chemistry Perspective (see Syllabus). This is a course for non-majors, and as such, students enrolled in Chem 315 include freshman, sophomores, juniors, and seniors from any university major. During the Fall 2007 semester, 11 students were enrolled.

The overall goal of the course is to expose students from varied backgrounds to a wide range of environmental topics. I typically cover topics such as greenhouse gases and global warming, alternative energy, water quality, and pesticide-use. Although these topics include many issues suitable for ethical analyses, prior to Fall 2007 I had never before covered ethics (at least not explicitly) as a unit of the course.

I was motivated to include ethics in an undergraduate (as opposed to a graduate) course for three reasons. First, ethical problem-solving is one of the major skills/attributes I often find lacking among beginning graduate students. Although it is unlikely the undergraduate students will stay at KSU for graduate school, my hope is that a background in ethics will be helpful to them wherever they choose to pursue their graduate studies. Second, I wanted to challenge a diverse group of students to think about the environmental ethical dilemmas they are likely to encounter in everyday life. Often, upon first exposure to such dilemmas, students believe the problems have easily-attained right or wrong answers. My teaching goals were to expose students to the issues, help them to thoroughly explore the complexity of the dilemmas, and provide them with a new, systematic decision-making system so they can reach ethical solutions.

## IMPLEMENTATION

I introduced ethics just after completing the first unit in the course, about two weeks into the semester. I devoted one lecture to ethical issues underlying environmental science (see PowerPoint lecture). The lecture covered several methods of ethical decision making, but I distilled them into a six-step procedure to provide the students with a systematic approach for analyzing ethical situations. The lecture set the stage for a class discussion in which I presented them a sample case study problem:

> *Your dorm refrigerator fails mid-semester. You never use it, so it sits until after finals. You are in a hurry to leave late Friday and Howie's is closed. A friend says you can get rid of it by leaving it at Washington-*

*Marlatt Park. "There's never anybody out there," he says, "so you won't get caught. And they pick up the garbage weekly so it won't sit there long."*

Using the methods and the technical language of ethical decision-making I had just presented, the class discussed solutions to this problem together. I then assigned a homework problem, asking the students to use the six-step process to solve another ethical dilemma (see Assignment). No additional reading outside of class was required for students to complete the assignment.

Students were given the opportunity to demonstrate their skills in ethical analysis on one exam question, worth 15 points:

*The exhaust system in your car develops a leak, causing it to produce a horrendously loud noise when you drive it. You take it in to the shop and the mechanic tells you your catalytic converter has been damaged and needs to be replaced. It'll cost a total of $450 for the repair. You don't have this kind of money available and leave in despair. Soon after, you run into a friend who says he has an old piece of exhaust pipe and can simply remove your catalytic converter and replace it with the pipe – for free! He adds: "Kansas has no emissions testing, so even though this is illegal, you'll never get caught."*

*Provide a detailed analysis of the ethics associated with accepting your friend's offer, using the six-step process described in class. Be sure to include relevant facts associated with the environmental chemistry and the purpose of the catalytic converter! You may use any literature or online resources, but you may not discuss your answer with anyone [15 pts].*

This exam question was given to the students as a take-home, so the students had ample time to think about and analyze the case. I used a rubric to assess their performance on the exam.

## STUDENT WORK

Students performed very well on their homework. Essentially, they followed very closely the systematic procedure I had given them. In fact, I was amazed at how rigidly they adhered to the procedure! The students also performed well on the exam question: nine of 11 students earned an A grade on the ethics portion of the exam (see Grade Distribution). For examples of students' work, see the link at right.

Common difficulties that I observed on the assignment and the exam question included students presenting issues under the incorrect topical heading (e.g. making a judgment in the consequences section) on the analysis steps I asked them to complete. They seemed to struggle most with reducing each problem into its component parts and then logically

organizing the components within the procedure given. Some also struggled to present both sides of the issue at hand.

## REFLECTION

The students appeared to enjoy discussing the ethical dilemmas and seemed to like the systematic approach to solving the problems. They also appreciated the objective language, which allowed them to discuss the issues without biases their own language typically reveals. Overall, the students seemed very engaged in the topic and the discussions; many students gave positive feedback about the ethics portion of the course on the final course evaluations (see Evaluations). Teaching ethics seemed to increase student interest in chemistry, perhaps because the dilemmas helped to illustrate both the far-reaching and personal consequences that result from decisions made in the environmental chemistry field.

I was glad that I introduced the ethical analyses early in the course, because doing so provided the students with a framework for analyzing other issues we encountered later in the semester. At least four times (following the initial lesson) the class discussed environmental issues in the context and language of ethical decision-making. In fact, the students adopted the six-step process so rigidly that it was difficult to get them to imagine what their answer might have been without going through the six steps.

Next time I teach the course, I plan to bring up an ethical issue in a preliminary discussion (before giving them background or decision-making tools), argue it, and then have them analyze it….just so they can compare their initial gut reaction with the conclusion obtained through the more systematic process. I also might add another scenario to give the students more opportunity to practice their ethical decision-making skills.

One of the biggest challenges I faced was in grading the assignments and the exam. Even with the rubric as a guide, I struggled with making clear judgments about what students said and found it difficult to quantitatively grade their work. While this may be alleviated with practice, I may also try to refine the rubric to more effectively discriminate levels of performance.

I plan to continue incorporating ethics into my teaching, particularly in the undergraduate course. Although I would like to incorporate ethics into my graduate level courses, I find it more challenging because those classes tend to be very technical in nature, narrow in scope, and focused on a specific field (e.g. optical spectroscopy). I am not sure how I would smoothly transition between technical skills and ethical reasoning in such courses. An introductory course for all chemistry graduate students that is similar to our current courses on safety and teaching skills would likely be the best place for ethics to be taught. We currently require the students participate in a ~ two-hour long ethics discussion (taught recently by myself and one other faculty member) at the beginning of their

graduate studies. But, this discussion currently emphasizes the "rules of conduct" in research and the consequences for those who don't follow them.

Including ethics in my undergraduate Environmental Science course has created teaching and learning opportunities for me professionally, as well. During the summer 2008, I made a public presentation to the American Chemical Society about the course and in doing so, highlighted the ethics topic as one new and integral component of the course. I also plan to submit a manuscript describing the incorporation of the ethics module into this course to a chemistry/science education journal in the near future.