

# Effective Approaches in Teaching Environmental Issues in Planetological Perspective

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How likely is it that the Earth will suffer either a human-made or natural disaster that will leave this planet a desolate wasteland? Cherif and Adams (1994) looked at some of the views scientists have formed on this possibility as a result of investigations of the conditions found on Venus and Mars, the two planets most similar to our own. As stated in Part I:

*We can use these planets as a kind of "experimental" Earth to ask, first, "What factors caused these planets to evolve differently from Earth?" and then, "What changes on Earth could lead to conditions like those found on other planets?" Answers to these questions may guide us to more accurate predictions about the potential effects of our actions on the sustained livability of our planet.*

(Cherif & Adams 1994)

A study of other planets can clearly be worthwhile to students in coming to grips with the possibility of changes that may happen to our own world. Teaching approaches that use "... students' experience, allow for active student involvement in the learning process, and that generate enthusiasm and interest are regarded to be essential to the learning process" (Cherif & Somerville 1992, p. 1). Although there are many ways to approach the teaching of environmental issues, two methods we found espe-

cially successful are peer teaching, and role playing/court-system teaching approaches. We will also describe additional ideas for assignments and other study methods applicable both to individual students and to groups.

## Peer Teaching Approach

In the peer teaching method, students teach each other. For example, when comparative studies are made of the planets Earth, Mars and Venus, we would divide a class of 30 into five groups. Each group would then be divided into three pairs of partners. Although they are provided with a list of questions that serves as a research guide, it is made known that they are free to incorporate additional information they feel is important. Each partner-pair takes as their personal research topic one of the planets under investigation. It should take no more than a couple of weeks for each pair to obtain sufficient information and write a brief description of their chosen planet, which is presented to the instructor. Once this material is reviewed by the instructor, the students use it to prepare one or more learning activities for their fellow group members.

Each group will probably stress different aspects of the comparisons among the planets, so a meeting of the entire class and a general discussion of the groups' results is held at the end of the project. This allows the groups to compare notes, discuss different learning activities and how they worked, and to summarize their combined knowledge about each of the planets. By the end of the experience, all students are responsible for submitting brief outlines of the knowledge they

gained from personal research and from their classmates' instruction.

We have found that students feel more comfortable when we place references in the classroom and/or library as a starting point for their investigations. This is especially effective for those pupils with limited research experience. It is also important to include questions from this activity in quizzes and examinations, and to tell students this will be happening.

## Role Play Teaching

In addition to thinking critically and analyzing and solving problems, the essence of role playing "... is the involvement of participants and observers in a real problem situation and the desire for resolution and understanding that this involvement engenders" (Joyce & Weil 1986, p. 242).

One role playing method that applies to planetology could involve dividing students into "interplanetary conferences." The class is divided into the following five groups: Earth representatives, Mars representatives, Venus representatives, media representatives, and an overall Conference Committee. The students serving as planetary representatives are provided an outline of their roles. Their job is to research the history and present conditions on their planet. In addition they are to forecast the changes they expect their planet to undergo in the future. The Conference Committee and media should have a general knowledge of the solar system and more detailed knowledge about Mars, Earth and Venus. The Conference Committee has the function of arbitrator in each of the following role playing scenarios:

**Scenario #1:** A new, uninhabited

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world has just been discovered. The representatives from each planet must justify before the Conference Committee why their group is the best suited to inhabit the new world. The Committee hears opening statements, debate and closing statements from each delegation. In addition, each delegation may create one visual advertisement to be displayed on the walls of the conference room to support their cause. The media cover the hearings, perhaps with television or radio coverage being produced by one subgroup, while other members, representing the print media, write a feature story.

At the end of the conference, the Conference Committee debates (briefly) behind closed doors before handing down their decision. At the end of the project, each delegation must submit a written report to the instructor consisting of the opening statements, closing statements and the key points in their argument. The media representatives submit their coverage of the conference in print, videotape, audiotape or other format. The Conference Committee submits a written report to the instructor consisting of the essence of the debate, the arguments, their final decision and the justification for their decision.

**Scenario #2:** The inhabitants of Mars and Venus wish to colonize Earth. The people of Earth see the present hostile conditions on both Mars and Venus, and fear something similar will happen to Earth if it is colonized by the Martians or Venusians. This scenario involves the inhabitants of each planet pleading their cause before the Conference Committee. The Martian and Venusian delegations have to assume the responsibility and defend themselves from the allegations of the inhabitants of the Earth. Again, the media cover the hearings. As before, the Conference Committee makes a decision based on the delegations' presentations. Material submitted to the instructor will be very similar to that for Scenario #1.

**Scenario #3:** The delegations and media representatives gather before the Conference Committee, not to inhabit and develop a new world, or to colonize an already inhabited planet, but to unite in an effort to preserve their own homes. Each delegation presents aspects of their own planet that are especially favorable, and what the major problems are on each planet. The role of the media remains the same, while the Conference Committee selects the best aspects of each planet's ecology to produce a unified plan for all the planets to follow together.

## Special Classroom Assignment

This is just one example of the kinds of activities that can stimulate students with special interests. Teachers can ask their students to plan an extended visit from one planet (their home) to another. They must begin by designing a method to explore the other world remotely and send back information about the place they intend to visit. Then, using the information they have obtained, they must design a means of getting to the planet, taking with them everything they need to survive. Justification for their design decisions should be written and will provide the primary basis for assessment by the teacher.

## Additional Teaching Ideas

1. Ask students to generate fact sheets about each planet using the accompanying article as a basis and finding other material using our bibliography as a guide. It is especially worthwhile to have them clearly distinguish between facts, and theories based on those facts. For example, it is a fact that the temperature on Mars varies between  $-120^{\circ}\text{C}$  and  $25^{\circ}\text{C}$ ; it is a theory that Mars once had running water on its surface.
  2. Ask students to consider the effects of moving a planet closer to the sun or farther away from the sun, and to address the following scenario. The people of each planet (Venus, Earth and Mars) are being compelled to give up their position in space, and to move either closer to the sun or farther away. The students, either individually or in groups (one group representing each planet), have to decide whether to move closer or farther, and must justify why they have made their decision. Their justification (presented in writing) should include the present conditions on their chosen planet and how those conditions might change as a result of a move in space. For example, by moving farther from the sun, the planet may cool slightly, but the year (and hence growing seasons) will be slightly longer as a result of the increased size of the orbit. These factors might thus tend to offset each other. As an extra factor, they may also choose to alter the seasonal variations of weather on
- their planet by adjusting planetary tilt; again, they should justify any changes on the basis of present conditions and how best to minimize any harmful effects (or maximize the beneficial ones) from a move in space.
3. For students interested in history, or as an activity combining history and science, have students prepare a research paper on the history of peoples' views of what other planets are like, comparing views from the time before space flight to our present views (as summarized in this paper). One source for information on how people viewed other planets before the advent of space flight is old textbooks and encyclopedias. (These views will be especially interesting to some students because they represent the scientific views of the time.) Another source of past perceptions could be various mythological views of the planets. (Greek, Chinese, Indian and Native American sources are all rich, although lacking somewhat in details of the conditions on these other worlds.) For students interested in science fiction, this is a rich source for historical views of what other planets were thought to be like, especially in stories written prior to the advent of actual planetary flights.
  4. Have students take the role of representative for one of the planets, and have them write a brochure to encourage tourism from some other planet or to warn the inhabitants of another planet about the effects of a nuclear war or some other disaster that has just taken place on their home world. Their writing should reflect the conditions on their home world and how the differences between the worlds would affect tourism, or the consequences of a disaster or nuclear war.
  5. In the book *Ecology and Our Endangered Life Support Systems*, by Eugene Odom (1991), the prologue examines the flight of Apollo 13 and the near disaster that threatened the lives of its crew. The author likens the damage accidentally sustained by the life support systems on the spacecraft to damage we are inflicting on our global life support system (the biosphere) by our deliberate activity as a society, and he contrasts the efforts to

assess the damage and save the three astronauts on Apollo 13 with efforts to "save" planet Earth from an ecological disaster. Students can be asked to read this very brief account as the prelude to a number of activities. In class discussion, a list could be put together of all the things affected by the accident that were needed by the astronauts and what features of our own environment these correspond to. Students might be asked to respond in writing, perhaps in a story putting themselves in the position of one of the astronauts, or one of the people on the ground trying to assist them in getting back alive. One or more students might conduct an interview (as a role playing activity), with other students taking the roles of astronauts, NASA representatives and government officials. It would then be interesting to compare these with actual interviews from newspapers published at the time of the incident, which can be found in most public or institutional libraries. (We strongly recommend Odom's book, or even just the prologue, as a basic reading to precede any of the other suggested activities.)

6. Have students examine a "standard" table of history of life on Earth (found as part of the "geologic time scale" in most standard earth science, biology and evolution texts), and identify areas that seem to be homocentric, that is, supporting the view that humans are the "ultimate" goal of evolution. One example of this is the tendency to view old organisms as "primitive" and new organisms as "advanced" or more complex, and hence better. In fact it is unclear, at best, whether a modern earthworm or a Cretaceous dinosaur is more "advanced" as an organism. The standard view portrayed in textbooks has been that evolution of life as a whole has been directional, with more advanced, more complex, "better" organisms replacing less advanced, less complex, poorly adapted ones. This leads to a view that *Homo sapiens*, highly advanced and complex, are the best organisms and are meant to dominate Earth. This idea, while perhaps comforting, is also often used by human societies as justification for the ecological disasters cre-

ated by their activities. We have attempted, in our writing about the histories of each planet, and of life on Earth, to eliminate these homocentric biases, but these and other biases surely remain to some extent.

### Acknowledgments

We would like to take this opportunity to thank our colleagues at the Department of Science and Mathematics, Columbia College, and the Aristotle Academy of Chicago, for their suggestions, encouragement and support. We also thank Joyce Gellhorn, whose careful reading, thorough suggestions and thought-provoking comments led to significant improvement of the original manuscripts. Finally, but not least, we would like to thank the many teachers in the Chicago area and elsewhere, who have used one or more of these suggested activities, and have given us much valuable feedback about their successes and difficulties.

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The references that follow summarize a large portion of the literature the authors examined during the preparation of this paper as well as Cherif and Adams (1992). It is included as a resource for instructors who wish to learn more about planetary, atmospheric and climate sciences, or who wish to refer their students to appropriate material on these subjects.

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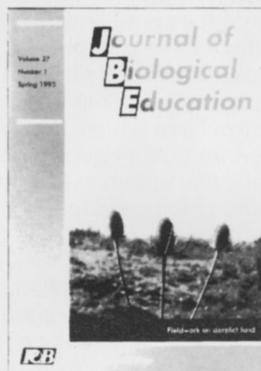
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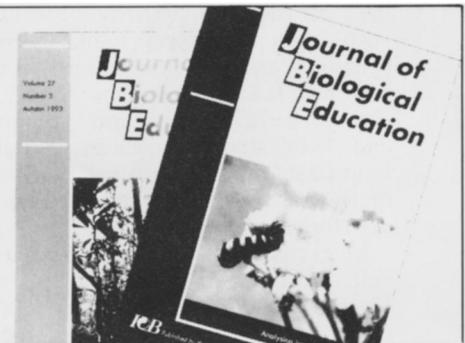
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