

PLANETARY SCIENCE AND ASTRONOMY IN THE MIDDLE SCHOOL CLASSROOM

L. M. French, Wheelock College, 200 The Riverway, Boston, MA 02215.

Astronomy and planetary science are of great interest to most middle and secondary school students. Many who think traditional biology, chemistry, physics, or earth science courses are dry or irrelevant are fascinated by the aesthetic and philosophical appeal of astronomy, and by the adventure of exploring other worlds. This high intrinsic interest makes planetary science and astronomy ideal media for teaching basic scientific and quantitative reasoning to students who might otherwise give up on science. During the period 1989-1992 the author integrated planetary science and astronomy into a fundamental course on physical science for eighth graders.

At the Park School, an academically rigorous independent school in Brookline, MA, eighth graders study astronomy and planetary science for approximately half the school year as part of an introductory physical science course. The classroom activities in astronomy are taken from the Project *STAR* curriculum [1], developed at the Harvard-Smithsonian Center for Astrophysics. Planetary topics included in the Project *STAR* curriculum include the phases of the Moon, the Earth's seasons, gravity, and building scale models of the Solar System. The remainder of the formal curriculum can be described as "hands-on chemistry". It is based on the text *Introductory Physical Science* [2]. Fundamental characteristic properties such as density, boiling point and melting point are introduced through laboratory activities and observations. Students become familiar with laboratory techniques and important planetary materials such as methane, sulfuric acid, carbon dioxide, hydrogen, and ammonia. Near the end of the course, students study a planetary object in detail. Astronomy, chemistry, and planetary science converge with the topics of light and spectroscopy: students learn to identify ionic compounds by flame tests. They then study the atomic model and learn that the color of light emitted by an atom is characteristic of that element. Finally, they build a spectrometer, observe absorption lines in the solar spectrum, and learn how astronomers use light to study distance objects.

Twice a year, students were asked to evaluate their science classes. The questions were simple:

- 1) What topic did you enjoy most and why?
- 2) What topic did you enjoy least and why?
- 3) What should definitely be taught again next year?
- 4) What suggestions can you make to help improve this course?

The 48 students in the eighth grade class during the 1991-92 school year gave the following responses:

- 1) Overall, approximately 68% of the students preferred astronomy or planetary science topics and activities.
- 2) 85% of the girls preferred astronomy or planetary science, while approximately equal numbers of boys preferred chemistry and astronomy.
- 3) Most students preferred the mathematical approach used in the Project *STAR* astronomy curriculum, which was based on geometry and similar triangles. The ratio problems found in the chemistry part of the course were originally algebraic in nature, and many students had difficulties setting up the ratios initially. Once they had been introduced to similar triangles, however, several students (all girls) devised methods of solving ratio problems using similar triangles. Even the students who preferred the chemistry subject matter said that the mathematics used in astronomy was easier to comprehend.

4) All of the students (male and female) who preferred chemistry would be ranked as outstanding science students by any criterion. The group preferring astronomy and planetary science included some outstanding science students but also many who struggled more in traditional science classes.

Sample Student Comments

From Girls:

- "Astronomy lets you think about where we came from and where we're going. It's cool."
- "I liked learning about photons and light and how stars shine."
- "I got ideas for new abstract artwork looking at pictures of the clouds of Jupiter for my research report."
- "Similar triangle problems helped me see how to set up ratios."
- "I preferred chemistry but doing similar triangles really helped students who had trouble. Both subjects were fun."

From Boys:

- "I liked both but chemistry was cooler because we got to light matches and do flame tests."
- "It was really neat to see how the different areas meet up--astronomers have to know about atoms and chemists have to know about light."
- "All the experiments with Bunsen burners should definitely be repeated. Those felt more like *real* science labs than playing with lenses did."
- "The planet project was one of the most fun research projects I've ever done. I could read scientific papers and sort of follow what they said."

Discussion

These results suggest that astronomy and planetary science may attract and keep the interest of students more effectively than chemistry, physics, or earth science alone. Among both boys and girls there appears to be a slight tendency to see chemistry as more "real" science than either astronomy or planetary science. This may not be bad, however, as both boys and girls responded favorably to the non-traditional sciences. The results suggest that astronomy and planetary science can play valuable roles in the middle school classroom as subjects that attract diverse students and as a means for introducing basic scientific reasoning.

The survey described here was informal and obviously based upon a small number of students. One possible source of bias should be noted: the students know that their teacher was a professional planetary astronomer. Since girls are, on average, more attuned to pleasing authority figures than boys, some girls may have shaded their responses more positively (either consciously or unconsciously) toward astronomy and planetary science. A more hopeful interpretation is that perhaps having a woman astronomer for a teacher intrigued and inspired the girls. A longer term study in collaboration with the current Park School science faculty is planned.

REFERENCES

- [1] Coyle, H. P., Gregory, B., Luzader, W. M., Sadler, P. M., and Shapiro, I. I. (1993) *Project STAR: The Universe in Your Hands*. Kendall-Hunt, Dubuque.
- [2] Haber-Schaim, U., Abegg, G. L., Dodge, J. H., Kirksey, H. G., and Walter, J. A. (1987). *Introductory Physical Science*. Prentice-Hall, Englewood Cliffs.