

## Perspectives on Science and Mathematics

Many math and science students are surprised to learn that math and science *have* a history at all; so far as they know, math and science have simply been handed down in textbooks. To discover that science has been accomplished by different kinds of people, for different kinds of reasons, in different kinds of places, can be truly mind-boggling, and, for many students, illuminating. Science is not just a matter of finding out the predetermined right answer! While some students are irked or even frightened by this discovery, others find it liberating.

Perspectives have several interlocking purposes:

- It is intended to help future math and science teachers learn how to think about math and science “from the outside”—to ask questions about what scientists and mathematicians do and why, about where science and technology came from and how they got to be so important in the world today, and about what kinds of questions scientists and mathematicians have tried to answer and why.
- It is designed to teach students skills of the liberal arts, including sophisticated research and information analysis, fluent writing, and substantive argument.
- It requires students to put to work all the perspectives and skills they have learned in science and math pedagogy.

Perspective, an upper-division course, is taught in two versions: one in the Philosophy department and one in the History department. Regardless of the department, four common elements show up in Perspectives: thinking about science and math “from the outside,” improving students’ writing skills, improving students’ research skills, and incorporating history and/or philosophy of science and math into pedagogy. Whether students take the History or Philosophy version depends on which class best fits their course schedule or is offered in a particular semester.

The two different versions of Perspectives have some different objectives and evidence. The following table includes objectives that are common to both the History and Philosophy versions; where the evidence varies in the two courses; examples of evidence from both versions are included.

### Course Procedures: Perspectives

#### Perspectives Philosophy Version

The Philosophy version of Perspectives proceeds chronologically, using philosophy texts and primary source material, with student presentations interspersed after the third week of material. The class meetings are a mix of instructor presentations and student discussion—ideally, each meeting should contain both. The course is divided into four main parts: introductory concepts and Ancient Greek sources; early modern philosophy, science, and mathematics; pre-modern biology through the modern Darwinian revolution; and nineteenth and twentieth century topics in science, philosophy of science, and mathematics.

The students take a field trip to the university's rare books and manuscripts collection sometime during the first half of the course to view rare books from the history of science. Some very early editions of Copernicus, Galileo, and Newton are available, and the staff can reserve a room for a class meeting with some advance notice.

Student presentations take the form of 5E lesson plans prepared and presented by pairs of students. Ideally, no more than two presentations should occur during a class meeting. In classes of more than 25 students, this means that students must work in pairs.

There are three 1,500-word papers due during the semester. Each student must choose a topic and take a stand on an issue. The topic should have philosophical interest as well as application to mathematics, science, computer science, or history. For their first papers, many students choose to defend rationalism or empiricism in their fields or attempt to mediate the dichotomy; or they may treat realism in mathematics or science as it related to a specific development. It is helpful to hold a paper topic workshop and try to hone a few topics based on the interests of the students in an interactive fashion.

#### Perspectives History Version

The History version of Perspectives has developed into a very resource- and labor-intensive course, for both instructor and students. In addition to the three one-hour lecture/discussion sessions per week, students attend one one-hour discussion section weekly, led by a graduate student teaching assistant from the History department. The course also employs a FSU-Teach teaching assistant, a student who has already taken the class, who coordinates the organization of students' 5E lessons and serves as a resource on matters pedagogical and FSU-Teach that are outside the expertise of the history teaching assistant (and sometimes of the instructor).

The course readings are drawn from primary materials from the seventeenth through the twentieth centuries. The students take three quizzes. Two of these are quizzes on historical material, consisting of short answers, chronology, and an essay question, and the third is a research-skills quiz.

Students write a great deal for the course. The major assignments consist of a brief, open-ended weekly writing assignment, a short research report paper (1,700 words), a longer research paper (3,500 words), and a 5E lesson plan that incorporates the history of science or math into a science or math lesson.

## Course Objectives: Perspectives

### Students Will Be Able To:

Develop an overview of the development of modern science and mathematics from the seventeenth through the twentieth centuries

Examine the underpinnings of modern science and mathematics by analyzing the contributions of key individuals, including Newton and Darwin

### Evidence (Student Products)

#### History

- Two quizzes on historical material
- Weekly writing assignment responding to an issue or question raised
- Two historical papers requiring research and analysis
- Participation in class and weekly section discussions
- Philosophy
- Participation in class discussions
- Essays explaining pre-modern, transitional, and modern frameworks in physics/cosmology, physiology, and biology
- Two quizzes

#### History

- Two quizzes on historical material
- Participation in class and weekly section discussions
- Weekly writing assignment responding to an issue or question raised
- Two research papers on aspects of the development of science and math
- Philosophy
- Two quizzes
- Three critical papers
- Three essays on topics of choice (e.g., Aristotelian/Ptolemaic worldview, Copernican and Galilean speculations, Aristotelian and medieval views on physiology and biology, tensions between realism and non-realism in math)

Express ideas and opinions clearly and effectively using a formal writing style

Develop skills in searching for, retrieving, and evaluating the provenance and reliability of source materials, including specific resources available to teachers

Integrate approaches and material learned in the course with independent research and science or math content to design middle and high school science and math lessons

## History

- Weekly writing assignment responding to an issue or question raised
- 1,700-word research paper
- 3,500-word research paper
- Philosophy
- At least three critical papers with appropriate topics, style, organization, and content
- Three essays on topics of choice

One research-skills quiz  
Annotated bibliographies for two historical papers  
Research skills workshop with university librarian

One 5E lesson plan designed for middle or high school students that addresses standards and integrates approaches and material learned in the course with independent research and science or math content  
5E lesson taught to peers  
Feedback on 5E lessons provided by peers