

Scientific Principles & Reasoning

Foundation Document

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Requirement Purpose

“Discovery,” as the biochemist Albert Szent-Gyorgyi said, “consists of seeing what everybody has seen and thinking what nobody has thought.” Courses fulfilling the Scientific Principles and Reasoning GE requirement—biological, physical, and social sciences—encourage students to sense the excitement of discovery. As expressed in the Aims of a BYU Education, students should be educated in “the basis concepts of the physical, biological, and social sciences” and in “the power and limitations of the scientific method.” These classes prepare the students to make informed decisions about science-related issues encountered in our increasingly technological world. They lay the foundation for lifelong learning about the sciences.

Learning Outcomes

Having completed this requirement, students will be able to

- demonstrate an understanding of the basic scientific principles which undergird the scientific process, including the strengths and weaknesses of this process.
- appreciate the excitement of discovery that has accompanied important scientific developments.
- demonstrate how scientific methodology can be used to analyze real-world science-related problems.
- evaluate scientific data and claims in order to make rational decisions on public-policy science issues that affect their community.
- express their thoughts (in oral, graphical, and written formats) on scientific topics clearly, including appropriate use of basic scientific vocabulary and effective interpretation of quantitative data.
- reflect rationally upon the interface between science and religion.

Course Characteristics

The courses adopt a conceptual framework that focuses on scientific thinking and reasoning as illustrated in a particular discipline. Vocabulary and principles of the discipline are included to provide a meaningful framework for discussion. However, the focus of the course should be on developing the student’s ability to reason using the tools of science rather than mastering large amounts of current scientific knowledge in a particular discipline. For this reason, courses should avoid content-driven presentations that are encyclopedic in nature. Conversely, the class must be more than a sterile presentation of the scientific method. A balance between disciplinary detail and scientific reasoning is ideal. This balance may vary, however, depending upon certain GE course sequences designated as “Options for Specific Majors” which satisfy both departmental and general education objectives.

Biological Science. Biology as a science branches down to the smaller and less familiar realms of cells and molecules and up to the larger scales of the entire Earth, and perhaps beyond. In some regards, it can be placed at the crossroads of physical science and the social sciences. Courses in the biological science area are expected to

1. illustrate use of the standard tools of science as applied and customized to biology, including the usual controlled experiments of science, the natural experiments and inference of historical science, and an examination of facts and data from otherwise uncontrollable situations.
2. involve students in the expanding interface between biology, technology, and biotechnology. As these advances accrue, the future can appear alternately bright or bleak from a human perspective.
3. provide students the opportunity to participate in individual discovery and exploration of the living world, while exposing them to the basic content knowledge they need to place it in societal and all-living-things context.
4. seek a balance between the understanding and practice of scientific methods and the vast language of fact and concept of the biological sciences.

Physical Science. We live in a physical universe. Our modern way of life requires that we understand and be able to productively use the physical laws that govern the world in which we live. Courses approved to meet the physical science requirement will

1. develop a heightened interest in the physical universe;
2. improve the students' ability to understand, explain and predict natural phenomena;
3. explain the process of scientific discovery, how others have used it, its strengths and limitations;
4. explore the "whys" and "hows" (the questions of physical science) as well as the "whats" (the facts of physical science) so that science is seen as a legitimate avenue of seeking truth;
5. understand and experience the power of physical science in addressing important contemporary issues with a technical component.

Social Science. Human behavior arguably represents the most complex and varied phenomenon to which the scientific method may be applied. The disciplines of the social sciences use various assumptions and methods of analysis in their efforts to explain the structure and behavior of individuals, families, and public and private institutions. Courses fulfilling this requirement are expected to devote significant portions of their course to the following:

1. An examination of the methodology and approach of a particular discipline within the social sciences;
2. Identification of the assumptions about human nature used by a given discipline;
3. The basic theory or models used to examine human behavior in that discipline;
4. An evaluation of evidence supporting or contradicting these theories and explanations;
5. Implications of this discipline's approach and findings for individuals, families, society, and public policies.

Students completing an approved course in the social sciences will have explicit knowledge and experience of both the strengths and the weakness of applying the scientific method to a particular set of problems and issues within a given discipline of the social sciences.