

Criteria for Approval of Natural Science courses for new Core

Purpose of Natural Science Requirement of the new Core

In Natural Science courses for the Core, students will learn theories and concepts central to the study of a particular topic within the natural sciences. While learning about the major topic of the course (e.g. biotechnology, endangered ecosystems, etc...), students will acquire a basic understanding of the methods and process of scientific inquiry, and how to distinguish scientific and non-scientific approaches. Students will demonstrate an ability to analyze scientific problems, obtain and evaluate relevant evidence, and appreciate that scientific knowledge involves degrees of certainty and ambiguity. These goals will be achieved with the assistance of a hands-on “laboratory” component.

The “Laboratory” Component of Natural Science Core courses

It is difficult, if not impossible, to really understand and appreciate the scientific process without actually undertaking scientifically-oriented observation, experimentation, and analysis. Thus, every Natural Science core course must include a hands-on component in which students actively engage in activities that involve careful scientific observation and experimentation, and thoughtful analysis. The instructor has discretion in how they incorporate these elements into their course. Some may focus on experimentation in the laboratory, while others may be oriented toward gathering data in the field, or even online. Some natural science disciplines lean more toward observation than experimental manipulation. Allowances will be made for diverse approaches, provided they still meet the learning goals and objectives defined for the Natural Science component of the core.

To ensure that students have the time and opportunity to engage directly in scientific methods, all natural science core courses must be scheduled to include a “lab” session – a course meeting time of at least two hours, separate from the normal weekly classroom periods, and meeting at least five times per quarter. For courses with a cap of 48, the standard lab schedule would have two lab sections meeting per week, with no more than 12 students in the lab at a time. Each student would therefore come to lab in alternating weeks. “Lab” sessions do not have to literally meet in a standard laboratory each week – instructors have discretion as to where the course meets, and what is actually done in the lab sessions, depending on the needs of the course.

Learning Goals and Objectives for the Natural Science Core component

Scientific Inquiry – Students develop a greater understanding of the principles of scientific inquiry, and how scientific methods and analysis are applied in the natural sciences.

- Students will understand how to formulate a testable hypothesis to explain phenomena observed in the natural world.
- Students will understand the concept of designing an experiment to test a hypothesis.
- Students will appreciate that there are different types of data, and understand the importance of gathering relevant data.
- Students will be able to interpret data (qualitatively and/or quantitatively), derive conclusions appropriate to the scope and quality of the data, and appreciate the limitations of experimental approaches and data sets.

- Students will understand the concepts of independent, dependent, and controlled variables, and will appreciate the importance of experimental controls.

Mathematical and quantitative reasoning – Students learn analytical, logical, and quantitative reasoning for problem solving.

- Students will be able to use basic mathematical and statistical methods to analyze data.
- Students will be able to mathematically evaluate variation in data, and understand its significance.

Critical thinking – Students learn the ability to identify, reflect upon, evaluate, integrate, and apply different types of information and knowledge to form independent judgments.

- Students will be able to interpret data, both qualitatively and/or quantitatively.
- Students will be able to derive conclusions appropriate to the scope and quality of the data.
- Students will learn to appreciate the limitations of experimental approaches, data availability, and data quality.

Complexity – Students learn an approach to understanding the world that appreciates ambiguity and nuance as well as clarity and precision.

- Students will be able to recognize limitations of experimental and observational methods.
- Students will understand the concepts of probability, causation, and correlation, and their relevance to interpreting scientific data.

Approval Process

Courses desiring to meet the Natural Science requirement of the new Core must be approved by the new Natural Science Faculty Core Committee. Courses approved for the current core must follow the same approval process as newly developed courses.

Faculty should prepare a general course description, and a prototype of the syllabus that would be provided to students. The course description should explicitly list learning goals and objectives for the course, and expected student outcomes. The learning goals and objectives should incorporate in some way the general learning goals and objectives laid out above, but they should be presented as they will be dealt with in the course. The course description should describe key assignments and activities, particularly in the lab component, and explain how they will contribute to accomplishing learning goals and objectives. Finally, faculty should describe planned strategies for assessment – i.e. how will it be determined whether, and to what extent, students are meeting the desired outcomes?

The prototype syllabus should lay out the organization of the course, and articulate clearly for students the learning goals and expected outcomes of the course. The *connection* between learning goals and assignments and activities should be explicit. The syllabus should also explain what assessment methods will be used.