

Attributes Required for Core II Physical & Natural Science Domain

This domain is intended to impart understanding of a recognized Natural and Physical Science field, including

- well-verified Facts and Relationships that have been discovered through the scientific method
- Theoretical and Conceptual framework within a causal paradigm that is fruitful and explanatory
- Skill and Practice in the performance, interpretation, and design of controlled experiments

Administrative aspects:

1. Possesses a detailed syllabus for both lecture and laboratory, complete enough that CoS CC is able to determine that the proposed course focus is aligned with the attributes described in this document.
2. Establishes ≥ 1400 minutes in a laboratory setting for experiential learning with faculty supervision (not including time spent on summative evaluation, nor time spent on pre-lab lecture) .
In most laboratory sessions students shall manipulate real devices and measure properties of actual materials; most of the other laboratory sessions will be based on real data (*i.e.*, $< 1/4$ of sessions use simulated data).
3. A course (or course pair, e.g. PHY 201+202) must exhibit all of the following attributes, in both categories.
CoS will thoroughly scrutinize each course component proposed for Core II Natural Science approval.

Experiment Attributes:

1. Treats the first-hand observation and measurement of Nature as the foundation of the science subject;
2. Imparts hands-on experience and develops skill in using devices to control, manipulate, and measure;
3. Practices empirical data collection, careful mathematical analysis, and awareness of uncertainties;
4. Teaches how to make observations, formulate hypotheses, and design experiments to test them;
5. Encourages students to appropriately interpret experimental results and communicate them effectively;
6. Impresses on the student the roles that calibration, precision, and accuracy play in validity of experiments;
7. Values the recognition of uncontrolled variables, and observer subjectivity and bias, in interpretation;
8. Values the understanding of basic principles inherent in the design, production, and use of equipment.

Concept & Theory Attributes:

1. Imparts a base of facts and theories needed to understand a recognized subject area in natural science;
2. Enables students to see unifying principles behind the body of knowledge, including atomic-scale principles;
3. Emphasizes the mathematical and/or logical rigor that is used to relate scientific concepts and explanations;
4. Empowers students to read articles on science, critically, and interpret them with comprehension, correctly;
5. Prepares students to reason about open-ended science-related issues, using science vocabulary correctly;
6. Teaches how to make quantitative predictions of observable quantities, in approximately realistic scenarios;
or, Teaches how to explain, via cause-and-effect, details which result from a complex interacting system;
7. Enables students to synthesize more complex results from more basic observations;
or, Discusses paradigm shifts (Kuhn) arising from anomalies being encountered by scientists;
8. Clarifies the tentative nature of Science's interpretation, built upon the enduring base of fact;
or, Enhances, encourages, and refines a skeptical approach toward the acceptance of statements;
9. Helps students recognize assumptions in a chain of reasoning, judge their validity, and explore implications.