Marshall University College of Science
Policy No. COS-Cur-01
Attributes Required for Core II Physical & Natural Science Domain

Effective Date: May 2, 2018

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 frameworks within a causal paradigm that is fruitful and explanatory
- skill and practice in the design, performance, and interpretation, of controlled experiments

1.0 Administrative aspects

1.1 Possesses a detailed syllabus for both lecture and laboratory, with supporting information, complete enough that COS CC is able to determine that the proposed course focus is aligned with the attributes described in this document. See additional notes below.

1.2 **For on-campus courses**, 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).

1.2.1 At least 50% of laboratory sessions must involve students manipulating real experimental devices and/or measuring/describing properties of actual materials. Less than 50% of lab sessions may use existing or virtual data, or simulations.

1.3 **For online courses**, the laboratory component must be roughly equivalent in scope and intellectual content to an equivalent course offered on campus. As for on-campus courses, at least 50% of laboratory sessions must involve students manipulating real experimental devices, and/or measuring/describing properties of actual materials. Less than 50% of lab sessions may use existing or virtual data, or simulations. Labs should be deliverable to the student to be done at home, either in kit form, using materials the students may have or be able to easily obtain, or some simulation/ imaging software. Plans for delivery of the required materials to students, and for receipt of materials that will evaluate and assess experimental planning, performance, and interpretation of experiments should be present in the submitted documentation. Online courses may be used for Core II Natural Science credit only by students enrolled in fully online degree programs.

1.4 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.

2.0 Experiment/ Lab problem Attributes

2.1 Treats the first-hand observation and measurement of natural and physical phenomena as the foundation of the science subject;

2.2 Imparts hands-on experience and develops skill in using devices/ protocols/ programs to control, manipulate, and measure;

2.3 Practices empirical data collection, careful mathematical analysis, and awareness of uncertainties;

2.4 Teaches how to make observations, formulate hypotheses, and design experiments to test them. The laboratory must go beyond the notion that experiments/ problem sets are pre-designed, and have one correct and unavoidable answer, and impart an understanding of uncontrollable variables, limitations of equipment and observation, and experimental error;

2.5 Encourages students to appropriately interpret experimental results and communicate them effectively;

2.6 Impresses on the student the roles that calibration, precision, and accuracy play in validity of experiments;
2.7 Values the recognition of uncontrolled variables, and observer subjectivity and bias, in interpretation;
2.8 Values the understanding of basic principles inherent in the design, production, and use of equipment.

3.0 Concept & Theory Attributes
3.1 Imparts a base of facts and theories needed to understand a recognized subject area in natural science;
3.2 Enables students to see unifying principles behind the body of knowledge;
3.3 Emphasizes the mathematical and/or logical rigor that is used to relate scientific concepts and explanations;
3.4 Empowers students to read articles on science, critically, and interpret them with comprehension, correctly;
3.5 Prepares students to reason about open-ended science-related issues, using scientific vocabulary correctly;
3.6 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;
3.7 Enables students to synthesize complex results from more basic observations;
or, Discusses paradigm shifts (Kuhn) arising from anomalies being encountered by scientists;
3.8 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;
3.9 Helps students recognize assumptions in a chain of reasoning, judge their validity, and explore implications.
3.10 Allows students to assess the quality of the data collected/ provided.

4.0 Required Documentation for Core II Approval
4.1 A course and lab syllabus that meet all of the Marshall University syllabus requirements, and lay out how the experimental, concept & theory attributes will be included in the course. This should not simply be a list of those attributes, it should be a specific explanation of how they will be met in that course, preferably with some examples from actual lab exercises.
4.2 Details on the laboratory exercises. It is not necessary to include every lab exercise, but the committee must be able to ascertain if the requirement of 50% of the labs involving experimentation and data collection by students is met, and if the core experimental attributes are being taught. Include enough to ensure that this assessment can be performed.
4.3 For online courses, provide details on how required materials will be delivered to the students. If packaged kits are to be used, list the source and cost of the kits and how they are to be ordered. If materials/ programs are to be prepared/ acquired by the instructor, list them and how the students will access them. This requirement must be met for all labs. The instructor must justify the techniques used in the labs.
4.4 If the proposed course is a new offering, all of the required forms to add a course to the catalog.