

Exploring Science

Student Learning Outcome: Students will demonstrate an ability to engage in scientific inquiry with respect to the natural world.

The Value of Exploring Science

Scientific inquiry is a systematic process that can be used to explore the natural world through a hypothesis-driven collection and analysis of evidence that results in informed and reproducible conclusions/judgments. Scientific analysis is the process of breaking complex topics or issues into parts to gain a better understanding of them. Many of the issues of the modern world rely on effective understanding and critical interpretation of scientific subject matter. These courses will provide students

with the necessary skills sets to make educated decisions using the empirical process as applied to issues in the natural world. They are designed to produce scientifically literate individuals who understand that scientific methods can be leveraged for the implementation of effective decision-making in a number of domains.

Supporting Skills

1. Students will identify and organize evidence necessary to analyze or solve a problem in the natural world.
2. Students will describe and explain concepts that are needed to analyze or solve a problem of the natural world.
3. Students will analyze the outcomes and consequences, given information about a natural phenomenon.

Course Content Criteria

1. Courses in this category focus on observable phenomena in the natural world.
2. Courses in this category emphasize the collaborative nature of scientific inquiry, including peer review.
3. Courses in this category give students the framework/tools to gather and assess empirical evidence and use that evidence to develop and test hypotheses.
4. Courses in this category develop students' quantitative literacy with the goal of interpreting empirical evidence.
5. Courses in this category develop students' understanding of the role of science and its impact on the world.
6. Courses in this category include an assessment assignment that requires students to demonstrate each of the skills in the Exploring Science Assessment Rubric (below). This assessment assignment should be one of the following: an objective exam, an essay question on an exam, an essay, or a research paper.

Glossary

1. **Empirical evidence:** Information acquired by observation, i.e., using the senses, or by experimentation. Validation of empirical evidence requires carefully designed frameworks, including appropriate controls and sufficient repetition.
2. **Falsifiable:** A property of a hypothesis where there is a test that could refute the hypothesis. As a result, scientific progress is made through the repetitive collection of disconfirming evidence that results in revision of scientific ideas and hypotheses.
3. **Framework:** A set of methodologies and tools whose sequencing, purpose, and execution are clearly defined. The exercise of this process is necessary to guarantee the reliability of gathering evidence, proposing hypotheses, conducting tests, analyzing data, and reproducing results in the practice of scientific inquiry. Examples include: Mathematical proof: an inferential argument for a mathematical statement, showing that the stated assumptions logically guarantee the conclusion. The preferred way for students to learn this framework is through laboratory exercises.
4. **Hypothesis:** A well-defined and specific prediction of the possible outcomes of a research question. A hypothesis must leverage existing scientific data and be falsifiable. A properly designed research project is rooted in the hypothesis and is constructed in a manner where the frameworks and tools of the study will result in data that is either consistent with, or falsifies, the central hypothesis. A hypothesis should be under constant revision as new scientific data or results accumulate.
5. **Method:** The process of careful observation, formulation of testable and falsifiable hypotheses, use of experiment or measurement to test deductions from the hypotheses, and refinement or elimination of hypotheses based on experimental findings.
6. **Observable phenomenon:** Any occurrence in the physical world that can be detected, described, measured, and recorded directly by people (i.e., by sight, sound) or indirectly through appropriate instrumentation (i.e., with a microscope, telescope).
7. **Peer review:** The process of critically evaluating scientific work, research, or ideas via the scrutiny of others who are experts in the same scientific discipline. It functions to encourage members of the scientific community to meet the accepted high standards of their discipline and to control the dissemination of unsubstantiated claims, unacceptable interpretations, or personal bias in the scientific literature.
8. **Quantitative literacy:** The ability to interpret and communicate numerical and mathematical information. It involves familiarity with the research methods that are used to gather, utilize, and analyze data, allowing one to make sense of the charts, graphs, tables, and statistics that are encountered in daily life.
9. **Tool:** A self-contained instrument or practice whose utilization is adopted to meet the needs or goals of a framework for scientific inquiry.

Exploring Science Assessment Rubric

Supporting Skills	Exemplary 5	Accomplished 4	Developing 3	Beginning 2	Absent 1
Identify and organize evidence necessary to analyze or solve a problem in the natural world.	Displays a superior ability to identify and organize relevant and critical evidence necessary to analyze or solve a problem in the natural world.	Displays a strong ability to identify and organize relevant evidence, but may miss some evidence, necessary to analyze or solve a problem in the natural world.	Displays a general ability to identify relevant evidence, but misses some critical evidence and may struggle to organize evidence, necessary to analyze or solve a problem in the natural world.	Displays an ability to identify some relevant evidence, but misses significant critical evidence and lacks the ability to organize evidence, necessary to analyze or solve a problem in the natural world.	Is unable to identify the relevant evidence necessary to analyze or solve a problem in the natural world.
Describe and explain concepts that are needed to analyze or solve a problem of the natural world.	Displays a superior ability to describe and explain concepts that are needed to analyze or solve a problem of the natural world.	Displays a strong ability to describe and explain concepts that are needed to analyze or solve a problem of the natural world, although there may be instances where there is difficulty describing or explaining a concept.	Displays a general ability to describe and explain most of the concepts that are needed to analyze or solve a problem of the natural world, but may do so with some inaccuracies and in limited detail.	Displays an ability to provide only a superficial description or explanation of the concepts needed to analyze or solve a problem of the natural world.	Is unable to describe or explain concepts that are needed to analyze or solve a problem of the natural world.
Analyze the outcomes and consequences, given information about a natural phenomenon.	Clearly and accurately analyzes, in significant depth, outcomes and consequences in terms of the given information.	Clearly and accurately analyzes, but in limited depth, outcomes and consequences in terms of the given information.	Generally analyzes outcomes and consequences in terms of the given information, but may misapply some information necessary for analysis.	Superficially analyzes outcomes and consequences in terms of the given information.	Is unable to analyze outcomes or consequences in terms of the given information.