

Natural Sciences *(Updated March 30, 2021)*

The Ohio Transfer 36 requires at least 6 semester hours of course credit in Natural Sciences, including at least one semester hour of course credit of Natural Sciences laboratory. Natural Sciences courses approved for inclusion within the Ohio Transfer 36 are introductory in nature, require college-level proficiencies appropriate to the course, and are taught at the lower division college level. Each course has a consistent content and a broad focus on one or more disciplines from within the physical and/or biological sciences, which include astronomy, biology, chemistry, environmental science, geology, physical geography and physics. Students completing courses in the Natural Science category should achieve the following learning outcomes through the study of natural sciences disciplines such as astronomy, biology, chemistry, environmental science, geology, physical geography, and physics.

As appropriate to the discipline, the course highlights the nature of science, the importance of experimental inquiry in the Natural Sciences, and the way in which such inquiry into the natural world leads scientists to formulate principles that provide universal explanations of diverse phenomena. The course fosters an understanding and appreciation that all applicable evidence must be integrated into scientific models of the universe, and that scientific models must evolve. A course that focuses primarily on content coverage, without addressing each of the Student Learning Outcomes described herein, is not suitable as an Ohio Transfer 36 Natural Sciences course.

In completing the Natural Sciences requirements within the Ohio Transfer 36, students will accurately understand and describe the scope of scientific study and core theories and practices, in either or both the physical and biological sciences, using appropriate discipline-related terminology.

Excluded courses:

- Remedial or developmental courses, special topics courses, narrowly focused courses, technical or pre-technical courses and skills-based courses.
- Courses that focus exclusively on content coverage without addressing the learning outcomes for the Ohio Transfer 36.
- Career preparation courses, non-credit continuing education courses, and life experience courses (unless life experience credit, such as military training or other prior learning experience, becomes approved in the future for an Ohio Transfer 36 credit by the statewide faculty review panel).

Learning Outcomes:

Upon completion of any approved Ohio Transfer 36 Natural Sciences course, students will be able to:

1. Understand the basic facts, principles, theories and methods of modern science.
2. Explain how scientific principles are formulated, evaluated, and either modified or validated.
3. Use current models and theories to describe, explain, or predict natural phenomena.

4. Apply scientific methods of inquiry appropriate to the discipline to gather data and draw evidence-based conclusions.
5. Demonstrate an understanding that scientific data must be reproducible but that it shows intrinsic variation and can have limitations.
6. Apply foundational knowledge and discipline-specific concepts to address issues or solve problems.
7. Explain how scientific principles are used in understanding the modern world, and understand the impact of science on the contemporary world.
8. Gather, comprehend, apply and communicate credible information on scientific topics, evaluate evidence-based scientific arguments in a logical fashion, and distinguish between scientific and non-scientific evidence and explanations.

Natural Sciences Laboratory Requirement: students will complete at least one course within the Natural Sciences Ohio Transfer 36 that includes a laboratory component. This laboratory component must carry at least one credit hour and involve at least 1,500 minutes of laboratory activities (an average of no less than two hours per week for a traditional 15-week semester). During the course, students will demonstrate the application of the methods and tools of scientific inquiry appropriate to the discipline, by actively and directly collecting, analyzing, and interpreting data, presenting findings, and using information to answer questions.

In addition to achieving the Student Learning Outcomes 1-8 detailed above, Ohio Transfer 36 approved courses that include a laboratory component¹ will achieve all the following student learning objectives in the equivalent of at least 10 weeks (~2/3) of the course's "laboratory activities":

- involves realistic measurements of physical quantities;
- involves data analysis, using data that are unique and/or physically authentic and that include random and/or systematic (natural) variability;
- includes realistic interactions with experimental apparatus, and realistic manipulation of tools/instruments and/or observed objects in space and time;
- involves synchronous feedback² on safety (and consequences of unsafe actions), correctness of procedure, and progress toward experimental goals; and
- involves effective interaction with the instructor at several points during each lab activity.

Footnotes:

1. *Some disciplines, such as astronomy, meteorology, and ecology, are more amenable to achieving a quality virtual educational lab experience. By contrast, other disciplines, such as chemistry*, microbiology and physics, are much less likely to meet the expectations of an Ohio Transfer 36 science lab course if focused heavily on virtual lab experiences.*

*[*The American Chemical Society has released a Position Statement on this issue:*

<https://www.acs.org/content/dam/acsorg/policy/publicpolicies/education/computersimulations/hands-on-science.pdf>

2. *Synchronous feedback on safety could be achieved using sophisticated computational approaches or by actual instructor feedback.*