PHYSICS (PHYS) - BACHELOR OF SCIENCE

Physicists are concerned with understanding the fundamental laws of Nature. The pursuit of that understanding leads to many practical applications. Physics is a rewarding area of study because it provides both a basis for understanding the natural world and modem technology, and satisfies one's intellectual curiosity. The fundamental character of physics makes it a discipline that is central to the liberal arts. The Physics curriculum at Western provides opportunities for students to take course work that supports other scientific and technical disciplines, to complete an academic major or minor, or to prepare for physics and engineering programs at other institutions.

Program Goals

- Students will obtain knowledge of the fundamental concepts of physics at a level reflected in typical current textbooks in the discipline.
- Students will learn to solve problems that might be encountered in practical situations and that might require several analytical steps to arrive at a solution.
- Students will learn to make a variety of experimental measurements, process data, interpret results, and report their findings in a literate fashion.
- Students will be able to generalize and apply physics concepts to other fields.

The courses listed for each of the following emphases are the minimum requirements. Higher-level supporting courses may be appropriate for students pursuing certain careers. Students should consult with their advisors for proper course selections. All majors require a Capstone Course.

- Physics Comprehensive Major: Applied Physics/Pre-Engineering Emphasis (https://catalog.western.edu/undergraduate/programs/physics/applied-physics-pre-engineering/)
- Physics Minor (https://catalog.western.edu/undergraduate/programs/physics/physics-minor/)

Capstone Course Requirement

The following course in the Applied Physics/Pre-Engineering Major fulfill the capstone course requirement: PHYS 495 Physics Capstone.

Physics Courses

PHYS 110. Introductory Astronomy (GT-SC2). (3 Credits)
An overview of the historical development of astronomy and the basic physical principles that are relevant to it. The overall structure of the Universe is studied and its various components examined. Includes limited observational activities. Prerequisite: completion of the general education essential skills mathematics requirement; or instructor permission. GT-SC2

PHYS 115. Physics of Music. (3 Credits)
A practical introduction to the physics of sound, with emphasis on music. Students investigate the properties of sounds produced by musical instruments. Topics include periodic functions, waves, resonance, overtones, frequency spectra, digital sound production and basic acoustic principles. Prerequisite: ACT math score of 19 or above; SAT math score of 500 or above; MATH 099 or university-level math requirement with a minimum grade of “C-”; or Accuplacer Advanced Algebra and Functions test score of 245 or above; or instructor permission.

PHYS 120. Meteorology (GT-SC2). (3 Credits)
A summary of the structure of the Earth's atmosphere, worldwide weather disturbances, weather forecasting, and snow avalanches. This course may not be taken for credit toward the Physics Minor. GT-SC2

PHYS 125. Energy and the Environment (GT-SC2). (3 Credits)
A practical study of energy generation and its environmental impact, including the physics of energy fundamentals, fossil fuel use, alternative energy uses, and energy conservation. Primarily for non-science majors, this course will qualitatively detail basic physical principles behind the use of energy, including mechanics, electricity and magnetism, and thermodynamics. This course is designed to provide the student with a physicist's perspective on energy use and environmental issues. Prerequisite: completion of the general education essential skills mathematics requirement; or instructor permission. GT-SC2

PHYS 140. Introductory Physics (with laboratory) (GT-SC1). (4 Credits)
A semi-quantitative introduction to the fundamental concepts of physical science, particularly the laws of physics as they relate to the structure of matter. Laboratory experiences play an important role in the investigations. This course may not be taken for credit toward the Physics Minor. Additional course fee applies. Prerequisite: ACT math score of 19 or above; SAT math score of 500 or above; MATH 099; Accuplacer Advanced Algebra and Functions test score of 245 or above; or instructor permission. GT-SC1

PHYS 170. Principles of Physics I (GT-SC2). (3 Credits)
A quantitative lecture introduction to the basic principles of physics. Topics covered include the motions of particles, forces in nature, energy, rotational motion, conservation laws, gravity and oscillations. A mathematical proficiency at the level of university algebra is recommended. Additional course fee applies. Prerequisites: MATH 141. Prerequisite or Corequisite: PHYS 185. Or instructor permission. GT-SC2

PHYS 171. Principles of Physics II (GT-SC2). (3 Credits)
A continuation of PHYS 170 dealing with waves, electromagnetism and light. Additional course fee applies. Prerequisite: PHYS 170. Prerequisite or Corequisite: PHYS 186. Or instructor permission. GT-SC2

PHYS 185. Laboratory Physics I (GT-SC1). (1 Credit)
A laboratory introduction to the basic principles of physics. Topics covered include the motions of particles, forces in nature, energy, rotational motion, conservation laws, gravity and oscillations. Additional course fee applies. Prerequisite or Co-requisite: PHYS 170 or PHYS 190; or instructor permission. GT-SC1

PHYS 186. Laboratory Physics II (GT-SC1). (1 Credit)
A laboratory introduction to the basic principles of physics dealing with waves, electromagnetism and light. Additional course fee applies. Prerequisite or Co-requisite: PHYS 171 or PHYS 191; or instructor permission. GT-SC1

PHYS 190. General Physics I (GT-SC2). (3 Credits)
A quantitative lecture introduction to the basic principles of physics, using the concepts of calculus as a tool. Topics covered include the motions of particles, forces in nature, energy, rotational motion, conservation laws, gravity, oscillations and waves. A student may not receive credit for both PHYS 170 and PHYS 190. Additional course fee applies. Prerequisite or Corequisite: MATH 151 and PHYS 185; or instructor permission. GT-SC2

PHYS 191. General Physics II (GT-SC2). (3 Credits)
A continuation of PHYS 190 dealing with electromagnetism and light. A student cannot receive credit for both PHYS 171 and PHYS 191. Additional course fee applies. Prerequisite: PHYS 190 (require minimum grade of C- or higher). Prerequisite or Corequisite: PHYS 186. Or instructor permission. GT-SC2

PHYS 197. Special Topics. (1-6 Credits)

PHYS 250. Statics. (3 Credits)
An investigation of systems in static equilibrium. Topics covered include force systems, 2d and 3d equilibrium, structural analysis, internal forces, friction, distributed forces and virtual work. Prerequisites: PHYS 171 or PHYS 190 and MATH 251 (all require minimum grade of C- or higher).

PHYS 251. Dynamics. (3 Credits)
An investigation of the kinematics and kinetics of particles and rigid bodies as well as modes of vibration and time response. Topics covered include coordinate systems, work-energy relations, momentum, relative motion and vibrations. Prerequisite: PHYS 250 or instructor permission.

PHYS 292. Independent Study. (1-6 Credits)

PHYS 297. Special Topics. (1-6 Credits)

PHYS 299. Internship. (1-6 Credits)

PHYS 320. Modern Physics. (3 Credits)
An introduction to the special theory of relativity, quantum physics, atomic physics, and sub-atomic physics. Prerequisites: PHYS 171 or PHYS 201; or instructor permission.; prerequisite or co-requisite: MATH 251.

PHYS 330. Classical Mechanics. (3 Credits)
A treatment of basic mathematical methods including vector analysis, coordinate systems and transformations, particle dynamics, energy, and gravitation. Prerequisites: PHYS 171 or PHYS 201; MATH 251; or instructor permission.

PHYS 335. Fluid Mechanics. (3 Credits)
Examines fundamentals of fluid flow with application to engineering problems. Topics covered include fluid statics and kinematics, Bernoulli equations, laminar and turbulent viscous boundary layers, laminar and turbulent pipe flow, and conservation equations for mass, momentum and energy. Prerequisites: MATH 251 and PHYS 250; or instructor permission.

PHYS 350. Electricity and Magnetism I. (3 Credits)
A study of electrostatic fields and potentials, the electrical properties of matter, magnetic phenomena and the magnetic properties of matter. Prerequisites: PHYS 171 or PHYS 201; MATH 252; or instructor permission.

PHYS 351. Electricity and Magnetism II. (3 Credits)
A continuation of PHYS 350 treating direct and alternating currents, electromagnetic induction, Maxwell's equations, and electromagnetic radiation. Prerequisite: PHYS 350 or instructor permission.

PHYS 392. Independent Study. (1-6 Credits)

PHYS 397. Special Topics. (1-6 Credits)

PHYS 399. Internship. (1-6 Credits)

PHYS 452. Quantum Mechanics. (3 Credits)
An introduction to the mathematical formalism of quantum mechanics and its application to various types of natural systems, such as multi-electron atoms, molecules, and solids. Prerequisites: PHYS 171 or PHYS 201; corequisite: MATH 252; or instructor permission.

PHYS 462. Astrophysics. (3 Credits)
A study of selected topics in astrophysics as they relate to the core areas of physics: mechanics, electromagnetism, quantum physics, and thermodynamics. Topics covered may include stellar formation and life cycles, galactic dynamics and dark matter, planetary systems, multiple star systems, interstellar medium, cosmology, and the nature of light. Prerequisites: PHYS 171 or PHYS 201; MATH 252; or instructor permission.

PHYS 492. Independent Study. (1-6 Credits)

PHYS 495. Physics Capstone. (1 Credit)
A senior research and thesis course. The course is designed as the last opportunity to develop skills required before students enter the work force, graduate school or the next step in a chosen vocation. Students shall choose individualized research projects in consultation with an instructor that utilize experimental analysis, experimental investigation and/or computational simulation. Students will communicate their results through written work and a presentation. This course may be taken multiple times for a maximum of 6 credits. Prerequisites: PHYS 320 or instructor permission.

PHYS 497. Special Topics. (1-6 Credits)

PHYS 499. Internship. (1-6 Credits)