PHYSICS MAJOR

ADMISSION TO THE MAJOR

The appropriate course for students considering a physics major depends primarily on their preparation. There are four common gateways into the major beginning in the fall semester.

- PHYS113 is a calculus-based introductory mechanics course requiring one semester of calculus, taken in either secondary school or in college, at about the level of MATH121. A student who has had no calculus should discuss with a member of the physics faculty whether to take calculus during the first year, then PHYS113 in the first semester of the sophomore year, or whether to try PHYS113 simultaneously with the first calculus course.
- Students who have had a strong preparation in physics and calculus may take PHYS215/PHYS219. These courses are intended for majors but are available to first-year or other students who have had both integral and differential calculus at about the level of MATH121/MATH122 and a solid course in mechanics with calculus at the level of PHYS113.
- Students from both of the above gateways merge into the electricity and magnetism course, PHYS116, in the spring. Students intending to major in physics should complete either track no later than the end of their sophomore year and preferably by the end of their first year.
- Exceptionally well-prepared students may begin with PHYS213. Students who feel that they fall into this category should consult with a member of the physics faculty.

Laboratory courses. The PHYS113/PHYS116 sequence has associated laboratory courses, PHYS123 in the fall and PHYS124 in the spring. These laboratory sections are half-credit courses associated with the lecture courses. PHYS124 is part of the required gateway to the major. We encourage students to take the laboratory courses for a firsthand opportunity to observe, both qualitatively and quantitatively, some of the physical phenomena discussed in the lectures.

MAJOR REQUIREMENTS

To major in physics, you must complete the requirements shown in the table below. The sequence of gateway courses described above provide the foundation for the core major courses. Students should complete PHYS116 no later than the end of your sophomore year; if you can complete it by the end of your first year, it will give you more flexibility to construct your major. You should also have completed MATH121, MATH122, MATH221, and MATH222 by the end of your sophomore year. It is desirable for those students who are considering graduate work in physics or those who wish to pursue an intensive major to also complete PHYS213 and PHYS214 by the end of the sophomore year. You should note that a few of the advanced courses may not be offered every year, and you should plan your program of study accordingly.

To fulfill the major in physics, a student must complete eight lecture courses and two laboratory courses. The lecture course requirement includes (a) four core physics courses which must be taken graded (A-F): PHYS213, PHYS214, PHYS316 and PHYS324; and (b) an additional four elective lecture credits at the 200, 300, or 400 level. At least one of the elective courses must be a PHYS lecture course at the 300 level, usually PHYS313 or PHYS315. The two laboratory courses can be chosen from PHYS342, PHYS345, PHYS340, or a 1-credit research tutorial with a physics faculty member. One of the two laboratory courses must be an advanced experimental laboratory class, currently PHYS342 or PHYS345.

Students planning graduate study in physics should take a minimum of 14 credits at the 200 level or higher in physics, mathematics, and computer science. PHYS313, PHYS315, and PHYS358 are essential. In addition, the department strongly recommends PHYS565, MATH226, and MATH229. Graduate physics courses may be elected with permission, and experience in computer programming is also extremely valuable. Students not planning graduate study in physics and who are interested in applying their knowledge of physics to other areas of the curriculum may substitute upper-level lecture courses from other departments to satisfy requirement (b) above. This must be done in consultation with the physics major advisor, and the selections must constitute a coherent, coordinated program of study. Substitution of more than two courses requires approval from the department. Preapproved tracks that satisfy requirement (b) are available here.

PHYSICS MAJOR REQUIREMENTS

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
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<tbody>
<tr>
<td>PHYS113</td>
<td>General Physics I</td>
</tr>
<tr>
<td>PHYS116 and PHYS124</td>
<td>General Physics II and General Physics Laboratory II</td>
</tr>
<tr>
<td>MATH221 or MATH223</td>
<td>Vectors and Matrices or Linear Algebra</td>
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<tr>
<td>MATH222</td>
<td>Multivariable Calculus</td>
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<tr>
<td>PHYS316</td>
<td>Thermal and Statistical Physics</td>
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Core Courses: Four required courses which must be taken graded (A-F)

- PHYS213
- PHYS214 (prerequisite MATH221 or MATH222. Math requirement can be taken concurrently)
- PHYS324 (prerequisite PHYS124 and MATH222)
- PHYS316

Electives: Four credits from the following list of lecture courses. * One of the four needs to be a 300-level physics course.

- PHYS207: Introduction to Biophysics
- PHYS215 (half credit): Special Relativity
- PHYS217
- PHYS219 (half credit): Introduction to Contemporary Physics
- PHYS313
- PHYS315: Classical Dynamics
- PHYS316: Quantum Mechanics II
- PHYS358 (Pre-requisite PHYS315): Condensed Matter Physics

Laboratory Courses:** Two laboratory courses

- PHYS342 (half credit): Experimental Optics
- PHYS345 (half credit): Electronics Lab
- PHYS340 (half credit): Computational Physics
- PHYS423/PHYS424 (1 credit): Research Seminar, Undergraduate

* It is possible for elective credits to be substituted by upper-level lecture courses in other departments. This must be done in consultation with the physics major advisor, and the selections must constitute a coherent, coordinated program of study. Preapproved tracks that satisfy the elective lecture course requirement are available.

** One of the laboratory courses must be an advanced experimental lab, currently either PHYS342 or PHYS345.
COURSES FOR NON-MAJORS

The Physics Department offers two two-semester survey courses covering many of the main subject areas of physics (mechanics, electromagnetism and optics, thermodynamics, and kinetic theory). PHYS111/PHYS112 uses less calculus and is often the choice for students studying physics for life science applications. PHYS113/PHYS116 uses more calculus and is the foundation for future work in physics, engineering, and related fields. Associated laboratory courses, PHYS121/PHYS122/PHYS123/PHYS124 are also offered. Either of these two-semester course sequences (with the lab) should satisfy the physics requirement for admission to most schools of medicine, dentistry, or architecture, but occasionally schools require the calculus-based series, so attention to these details is necessary.

STUDENT LEARNING GOALS

The course of study leading to the BA in physics is designed to guide students toward understanding how the universe works. In addition to mastering the concepts and mathematical structure of classical and quantum physics, students should develop the skills necessary to use these ideas for the benefit of humanity.

STUDY ABROAD

The Physics Department encourages study abroad for majors because it allows our physics majors to play an active part as citizens of the world scientific community. As with any major, careful planning is needed to be sure that requirements for the major are fulfilled, and sophomores intending to declare a physics major are strongly urged to study these requirements for the major so that they can determine the optimum semester to study abroad. At Wesleyan, we believe that the best study-abroad experience will include work done in the major, because this provides the student with a natural community of fellow students with shared interests and backgrounds and greatly facilitates the process of cultural integration. Physics majors are thus urged to consider direct enrollment in a university abroad, where they can take courses related to their major interests.

ADVANCED PLACEMENT

Students may receive a maximum of two physics AP credits; one with a score of 5 on the AP physics C mechanics exam and one with a score of 5 on the AP physics C electricity and magnetism exam. However, special regulations apply. Please check with the registrar or a departmental advisor. Students may also receive AP credit with a score of 5 on the noncalculus AP physics exam. Again, special regulations apply.

RELATED PROGRAMS OR CERTIFICATES

Dual-degree programs in science and engineering. Wesleyan maintains dual-degree programs with Columbia University, the California Institute of Technology, and Dartmouth College for students wishing to combine the study of engineering with a broad background in the liberal arts. For all options, participating students receive two degrees: a BA from Wesleyan and a BS or BE in engineering from our partner school. In the most popular option, the so-called 3-2 program, students spend their first three years at Wesleyan, followed by two years at the engineering school. Only at the end of the fifth year and after completing all degree requirements from both schools do students receive the two bachelor degrees. During the first three years, prospective 3-2 students complete the minimal requirements of their elected Wesleyan major and, in addition, fulfill science and mathematics requirements for the first two years of the engineering school and engineering major of their choice. During the two years at the engineering school, students follow the regular third- and fourth-year curriculum in whatever field of engineering they selected. During that time, other courses may also have to be taken to satisfy the degree requirements of Wesleyan and/or the engineering school.

Two other options exist to pursue an engineering degree. For Columbia University, the so-called 4-2 option allows students to complete four years at Wesleyan before pursuing the engineering degree. Otherwise, requirements are the same as those for the 3-2 program. Dartmouth offers a so-called 2-1-1-1 option in which students spend their junior year at Dartmouth, return to Wesleyan for their senior year and graduation, and then spend the fifth year to finish the engineering degree. Contact the dual-degree advisor for further information. Please also consult with your class dean to ensure that you can meet all Wesleyan University requirements for graduation.

Certificate Program in Informatics and Modeling. The Certificate Program in Informatics and Modeling enhances student choices and options and is an ideal supplement for interested physics majors. The certificate program provides students with a coherent set of courses and practical instruction in two pathways: (1) integrative genomics science and (2) computational science and quantitative world modeling.

BA/MA PROGRAM

This is a curricular option for those students who feel the need for the intensive research experience that an additional year of study can afford. During the additional year, the student will do additional coursework and write an MA thesis based on original research. Students interested in this possibility should consult their physics major advisors as early as possible, since it takes some planning to complete the requirements for both the BA and MA degrees. For more information, please visit wesleyan.edu/grad/degree-programs/bama.html.

HONORS

To be a candidate for departmental honors in physics, a major must submit a thesis describing the investigation of a special problem carried out by the candidate under the direction of a member of the Physics Department. In addition, the candidate must have attained a minimum average in the eight lecture courses applied to the major, except those taken in the final semester of the senior year, of B (85.0) for honors and B+ (88.3) for high honors. Honors status is voted by the faculty on the basis of the student’s thesis work.

CAPSTONE EXPERIENCE

The Physics Department offers the following capstone experiences:

- Two-semester senior thesis
- Seminar in atomic and molecular physics (PHYS507/PHYS508)
- Seminar in condensed matter physics (PHYS505/PHYS506)
- Seminar in theoretical physics (PHYS509/PHYS510)