

# PHYSICS, BA

**Degree:** Bachelor of Arts (BA)

**Major:** Physics

## Program Overview

The mission of the Bachelor of Arts degree with a Major in Physics is to provide an education in fundamental areas of physics, including classical mechanics, electromagnetism, quantum mechanics, thermal physics/statistical mechanics, and laboratory, data analysis and computational skills, while offering maximum flexibility to pursue other interests. Compared to our B.S. degree, there are 27 fewer required credits of physics courses, including 3 fewer advanced laboratory courses. This makes the B.A. degree particularly attractive to students who wish to combine a study of physics with the pursuit of other interests or customize their physics degree with courses of their own choosing. Such students often complete a second major in the arts, humanities or social sciences and they may apply to a professional program in medicine, law or business after completing their B.A. Understanding the scientific enterprise can be crucial in business, finance, medicine, law, the media, literature, the arts, general education, government, and any number of other pursuits.

The required physics courses provide exposure to a broad range of physical phenomena as well as training in the scientific method, techniques of problem solving, data analysis, quantitative approaches to physical problems, and experimental procedures. Although less intense than the B.S. program, the B.A. program can, with a judicious choice of electives, provide an excellent preparation for graduate study in physics. At the same time, a reduced requirement for technical courses in the physics B.A. program provides an opportunity to explore other disciplines in depth.

The freshman year is very similar for B.A. and B.S. students, the only differences being that the B.A. student has a wider choice of non-physics science electives and may choose to take the introductory physics and math courses designed for life science students. B.A. majors who choose to do their capstone through the Department of Physics have worked on a wide variety of topics with mentors from departments across campus and even off-campus.

## Teacher Licensure

This program offers a special option for undergraduate students who wish to pursue this major and a career in teaching. The Teacher Education Program prepares CWRU students to receive an Ohio Teaching License for grades K-12 (Multi-Age) or grades 7-12 (Adolescent to Young Adult (AYA)) depending on major area of study. Students declare a second major in education—which involves 36 hours in education and practicum requirements—and complete a planned sequence of major content coursework within the context of this major. The program is designed to offer several unique features not found in other programs and to place students in mentored teaching situations throughout their teacher preparation career. This small, rigorous program is designed to capitalize on the strengths of CWRU's departments, its Teacher Education Program, and the relationships the university has built with area schools. For the subject area requirements for teacher licensure, please visit the program page for the Teacher Education, BA.

## Undergraduate Policies

For undergraduate policies and procedures, please review the Office of Undergraduate Studies section of the General Bulletin.

## Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the Office of Undergraduate Studies section of the General Bulletin.

## Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the general requirements of the College of Arts and Sciences. Students completing this program as a secondary major while completing another undergraduate degree program do not need to satisfy the latter set of requirements.

The Bachelor of Arts degree with a physics major requires completion of the Arts and Sciences General Education Requirements (GER) and 120 total credits, of which 50 are specified by the physics department as shown below. Courses specified for this major satisfy the 6-credit Arts and Sciences GER in Sciences and Mathematics.

Code	Title	Hours
One of the following:		4
PHYS 115	Introductory Physics I	
PHYS 121	General Physics I - Mechanics	
PHYS 123	Physics and Frontiers I - Mechanics	
One of the following:		4
PHYS 116	Introductory Physics II	
PHYS 122	General Physics II - Electricity and Magnetism	
PHYS 124	Physics and Frontiers II - Electricity and Magnetism	
All of the following:		
PHYS 221	Introduction to Modern Physics	3
PHYS 301	Advanced Laboratory Physics I	3
PHYS 303	Advanced Laboratory Physics Seminar	1
PHYS 310	Classical Mechanics	3
PHYS 313	Thermodynamics and Statistical Mechanics	3
PHYS 324	Electricity and Magnetism I	3
PHYS 331	Introduction to Quantum Mechanics I	3
All of the following:		
Intro Science 1 <sup>1</sup>		3
Intro Science 2 <sup>1</sup>		3
ENGR 131	Elementary Computer Programming	3
or CSDS 132	Programming in Java	
MATH 121	Calculus for Science and Engineering I	4
or MATH 125	Math and Calculus Applications for Life, Managerial, and Social Sci I	
One of the following:		4
MATH 122	Calculus for Science and Engineering II	
MATH 124	Calculus II	
MATH 126	Math and Calculus Applications for Life, Managerial, and Social Sci II	

MATH 223 or MATH 227	Calculus for Science and Engineering III Calculus III	3
MATH 224	Elementary Differential Equations	3
SAGES First and University Seminars		10
SAGES Departmental Seminar <sup>2</sup>		2-3
SAGES Capstone <sup>3</sup>		3-4
Breadth Requirements <sup>4</sup>		12
Open electives <sup>5</sup>		43-41
PHED Physical Education (2 semesters)		0
<b>Total Hours</b>		<b>120</b>

<sup>1</sup> A two-course science sequence chosen from:

- ASTR 221 and ASTR 222;
- CHEM 105 and CHEM 106;
- CHEM 111 and ENGR 145;
- BIOL 214 and BIOL 215;
- EEPS 101 or EEPS 110;
- EEPS 115 or EEPS 117

• or another two-course sequence totaling 6 or more credits in a quantitative science (other than physics), with approval of the physics undergraduate program committee.

<sup>2</sup> PHYS 303 + PHYS 352 can be used to satisfy this requirement.

<sup>3</sup> PHYS 351 can be used to satisfy this requirement.

<sup>4</sup> The breadth requirements include 6 hours of Social Sciences and 6 hours of Arts and Humanities. This may increase by 3 credits if the required Global and Cultural Diversity course is not also one of the breadth requirement courses. Courses required for the BA in Physics satisfy the 6-credit GER for Natural Sciences and Mathematics as well as the Quantitative Reasoning course requirement.

<sup>5</sup> The number of open electives will vary depending on course choices made by each student. The BA degree requires a minimum of 30 semester hours at the 300-400 level, of which only 16 are specified as PHYS courses. No more than 42 hours beyond the 100-level in any one department (*the physics BA specifies 19 such credits*) may be applied to the 120 credit total and at least 90 credits must be in the College of Arts and Sciences.

## Sample Plan of Study

### First Year

<b>Fall</b>		<b>Hours</b>
PHYS 121 or PHYS 123	General Physics I - Mechanics or Physics and Frontiers I - Mechanics	4
MATH 121	Calculus for Science and Engineering I	4
Intro Science Elective I		3
SAGES First Seminar		4
PHYS 166	Physics Today and Tomorrow	1
PHED Physical Education Activities		0
<b>Hours</b>		<b>16</b>
<b>Spring</b>		
MATH 122	Calculus for Science and Engineering II	4

PHYS 122 or PHYS 124	General Physics II - Electricity and Magnetism or Physics and Frontiers II - Electricity and Magnetism	4
Intro Science Elective II		3
University Seminar		3
ENGR 131	Elementary Computer Programming	3
PHED Physical Education Activities		0
<b>Hours</b>		<b>17</b>

### Second Year

#### Fall

PHYS 221	Introduction to Modern Physics	3
MATH 223	Calculus for Science and Engineering III	3
University Seminar		3
Humanities/Social Science Elective		3
Open Elective		3
<b>Hours</b>		<b>15</b>

#### Spring

MATH 224	Elementary Differential Equations	3
PHYS 310	Classical Mechanics	3
Humanities/Social Science Elective		3
Open Elective		3
Open Elective		3
<b>Hours</b>		<b>15</b>

### Third Year

#### Fall

PHYS 301	Advanced Laboratory Physics I	3
PHYS 303	Advanced Laboratory Physics Seminar	1
PHYS 313	Thermodynamics and Statistical Mechanics	3
PHYS 331	Introduction to Quantum Mechanics I	3
Humanities/Social Science Elective		3
Open Elective		2
<b>Hours</b>		<b>15</b>

#### Spring

Global and Cultural Diversity Elective		3
PHYS 324	Electricity and Magnetism I	3
Humanities/Social Science Elective		3
Open Elective		3
Open Elective		3
<b>Hours</b>		<b>15</b>

### Fourth Year

#### Fall

PHYS 351	Senior Physics Project	2
PHYS 352	Senior Physics Project Seminar	1
Open Elective		3
Open Elective		3
Open Elective		3
Open Elective		3
<b>Hours</b>		<b>15</b>

#### Spring

PHYS 351	Senior Physics Project	2
PHYS 352	Senior Physics Project Seminar	1

Open Elective	3
Open Elective	3
Open Elective	3
<b>Hours</b>	<b>12</b>
<b>Total Hours</b>	<b>120</b>