

Physics | American River College


If you wish to pursue a career in physics or a related field, ARC's Physics program offers you a strong foundation. Through this program, you have a number of course options to fulfill a GE requirement and/or needed physics coursework required for your major. You will be required to take some course work in physics if you major in, for example, biology, chemistry, many pre-health fields, engineering, mathematics, or computer science.

Career Options


The [Careers Toolbox for Undergraduate Physics Students](https://www.spsnational.org/sites/all/careertoolbox/) (<https://www.spsnational.org/sites/all/careertoolbox/>) is a great place to start exploring career options for physics majors. For more detailed information, you can find a variety of up-to-date employment data and reports for physicists, astronomers, and related scientists [here](https://www.aip.org/statistics/employment) (<https://www.aip.org/statistics/employment>). Many other career and internship-related resources are available to you at the [AAPT Career Center](https://jobs.aapt.org/jobseekers/resources/) (<https://jobs.aapt.org/jobseekers/resources/>).

[\(/academics/arc-program-road-maps\)](/academics/arc-program-road-maps)

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Associate Degrees for Transfer

A.S.-T. in Physics

The Associate in Science in Physics for Transfer provides students with a major that fulfills the general requirements of the California State University for transfer. Students with this degree will receive priority admission with junior status to the California State University system.

The Associate in Science in Physics for Transfer (A.S.-T.) may be obtained by the completion of 60 transferable, semester units with a minimum of a 2.0 GPA, including (a) the major or area of emphasis described in the Required Program outlined below (earning a C or better in these courses), and (b) the Intersegmental General Education Transfer Curriculum (IGETC).

Students interested in transferring to a CSU campus to pursue a bachelor's degree in physics should meet with a counselor to confirm the courses required for lower division preparation in the major. Although additional preparatory courses are not required for this degree, students will be better prepared if they complete differential equations, linear algebra, general chemistry, and at least one computer programming course prior to transferring.

Catalog Date: June 1, 2019

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
MATH 400	Calculus I	5
MATH 401	Calculus II	5
MATH 402	Calculus III	5
PHYS 410	Mechanics of Solids and Fluids	5
PHYS 421	Electricity and Magnetism	4

COURSE CODE	COURSE TITLE	UNITS
PHYS 431	Heat, Waves, Light and Modern Physics	4
Total Units:		28

The Associate in Science in Physics for Transfer (AS-T) degree may be obtained by completion of 60 transferable, semester units with a minimum 2.0 GPA, including (a) the major or area of emphasis described in the Required Program, and (b) the Intersegmental General Education Transfer Curriculum (IGETC).

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation.
- solve problems requiring the application of physics and mathematics up through calculus.
- interpret the results of physics calculations.
- define common physics terms and physical laws.
- compose a well-organized and complete lab report.

Career Information

This degree is designed to facilitate students' successful transfer to four-year programs that prepare them for advanced study in physics and other related fields, including biophysics, physical chemistry, geophysics, and astrophysics. Physicists with undergraduate and graduate degrees have a broad range of employment opportunities, including high technology, computer programming, research, and teaching.

Associate Degrees

A.S. in General Science

This program provides a broad study in the fields of biological and physical sciences in preparation for transfer to a four-year program and continuation of studies in upper division science courses.

Catalog Date: June 1, 2019

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
A minimum of 18 units from the following:		18 ¹
Physical Science Courses		
ASTR 300	Introduction to Astronomy (3)	
ASTR 310	The Solar System (3)	
ASTR 320	Stars, Galaxies, and Cosmology (3)	
ASTR 330	Introduction to Astrobiology (3)	
ASTR 400	Astronomy Laboratory (1)	
ASTR 481	Honors Astronomy: Stars, Galaxies, and Cosmology (4)	
ASTR 495	Independent Studies in Astronomy (1 - 3)	
ASTR 499	Experimental Offering in Astronomy (0.5 - 4)	
CHEM 305	Introduction to Chemistry (5)	

COURSE CODE	COURSE TITLE	UNITS
CHEM 306	Introduction to Organic and Biological Chemistry (5)	
CHEM 309	Integrated General, Organic, and Biological Chemistry (5)	
CHEM 310	Chemical Calculations (4)	
CHEM 400	General Chemistry I (5)	
CHEM 401	General Chemistry II (5)	
CHEM 420	Organic Chemistry I (5)	
CHEM 421	Organic Chemistry II (5)	
CHEM 423	Organic Chemistry - Short Survey (5)	
CHEM 495	Independent Studies in Chemistry (1 - 3)	
CHEM 499	Experimental Offering in Chemistry (0.5 - 4)	
GEOG 300	Physical Geography: Exploring Earth's Environmental Systems (3)	
GEOG 301	Physical Geography Laboratory (1)	
GEOG 305	Global Climate Change (3)	
GEOG 306	Weather and Climate (3)	
GEOG 307	Environmental Hazards and Natural Disasters (3)	
GEOG 308	Introduction to Oceanography (3)	
GEOG 309	Introduction to Oceanography Lab (1)	
GEOG 391	Field Studies in Geography: Mountain Landscapes (1 - 4)	
GEOG 392	Field Studies in Geography: Coastal Landscapes (1 - 4)	
GEOG 393	Field Studies in Geography: Arid Landscapes (1 - 4)	
GEOG 394	Field Studies in Geography: Volcanic Landscapes (1 - 4)	
GEOG 495	Independent Studies in Geography (1 - 3)	
GEOG 499	Experimental Offering in Geography (0.5 - 4)	
GEOL 300	Physical Geology (3)	
GEOL 301	Physical Geology Laboratory (1)	
GEOL 305	Earth Science (3)	
GEOL 306	Earth Science Laboratory (1)	
GEOL 310	Historical Geology (3)	
GEOL 311	Historical Geology Laboratory (1)	
GEOL 320	Global Climate Change (3)	
GEOL 325	Environmental Hazards and Natural Disasters (3)	
GEOL 330	Introduction to Oceanography (3)	
GEOL 331	Introduction to Oceanography Lab (1)	
GEOL 345	Geology of California (3)	
GEOL 390	Field Studies in Geology (1 - 4)	
GEOL 495	Independent Studies in Geology (1 - 3)	
GEOL 499	Experimental Offering in Geology (0.5 - 4)	
PHYS 310	Conceptual Physics (3)	
PHYS 311	Basic Physics (3)	

COURSE CODE	COURSE TITLE	UNITS
PHYS 312	Conceptual Physics Laboratory (1)	
PHYS 350	General Physics (4)	
PHYS 360	General Physics (4)	
PHYS 410	Mechanics of Solids and Fluids (5)	
PHYS 421	Electricity and Magnetism (4)	
PHYS 431	Heat, Waves, Light and Modern Physics (4)	
PHYS 495	Independent Studies in Physics (1 - 3)	
PHYS 499	Experimental Offering in Physics (0.5 - 4)	
PS 300	Introduction to Physical Science (3)	
PS 301	Physical Science Laboratory (1)	
PS 495	Independent Studies in Physical Science (1 - 3)	
PS 499	Experimental Offering in Physical Science (0.5 - 4)	
Biological Science Courses		
ANTH 300	Biological Anthropology (3)	
ANTH 301	Biological Anthropology Laboratory (1)	
ANTH 303	Introduction to Forensic Anthropology (3)	
ANTH 370	Primatology (3)	
ANTH 372	Primatology Field Studies (2)	
ANTH 480	Honors Biological Anthropology (3)	
ANTH 495	Independent Studies in Anthropology (1 - 3)	
ANTH 499	Experimental Offering in Anthropology (0.5 - 4)	
BIOL 300	The Foundations of Biology (3)	
BIOL 301	Evolution (3)	
BIOL 303	Survey of Biology (4)	
BIOL 305	Natural History (4)	
BIOL 310	General Biology (4)	
BIOL 322	Ethnobotany (3)	
BIOL 332	Introduction to Ornithology (4)	
BIOL 342	The New Plagues: New and Ancient Infectious Diseases Threatening World Health (3)	
BIOL 352	Conservation Biology (3)	
BIOL 370	Marine Biology (4)	
BIOL 375	Marine Ecology (3)	
BIOL 390	Natural History Field Study (0.5 - 4)	
BIOL 400	Principles of Biology (5)	
BIOL 410	Principles of Botany (5)	
BIOL 415	Introduction to Biology: Biodiversity, Evolution, and Ecology (5)	
BIOL 420	Principles of Zoology (5)	
BIOL 430	Anatomy and Physiology (5)	
BIOL 431	Anatomy and Physiology (5)	

COURSE CODE	COURSE TITLE	UNITS
BIOL 440	General Microbiology (4)	
BIOL 442	General Microbiology and Public Health (5)	
BIOL 482	Honors Marine Biology (4)	
BIOL 495	Independent Studies in Biology (1 - 3)	
BIOL 499	Experimental Offering in Biology (0.5 - 4)	
BIOT 301	Biotechnology and Human Health (3)	
BIOT 305	Introduction to Bioinformatics (1)	
BIOT 307	Biotechnology and Society (2)	
BIOT 311	Biotechnology Laboratory Methods - Molecular Techniques (2)	
BIOT 312	Biotechnology Laboratory Methods - Microbial and Cell Culture Techniques (2)	
BIOT 499	Experimental Offering in Biology (0.5 - 4)	
NATR 300	Introduction to Natural Resource Conservation and Policy (4)	
NATR 302	Introduction to Wildlife Biology (4)	
NATR 303	Energy and Sustainability (3)	
NATR 304	The Forest Environment (3)	
NATR 305	Fisheries Ecology and Management (4)	
NATR 306	Introduction to Rangeland Ecology and Management (3)	
NATR 307	Principles of Sustainability (4)	
NATR 310	Study Design and Field Methods (4)	
NATR 320	Principles of Ecology (4)	
NATR 322	Environmental Restoration (2)	
NATR 324	Field Studies: Birds and Plants of the High Sierra (1.5)	
NATR 330	Native Trees and Shrubs of California (4)	
NATR 332	Wildflowers of California (3)	
NATR 346	Water Resources and Conservation (3)	
NATR 495	Independent Studies in Natural Resources (1 - 3)	
NATR 499	Experimental Offering in Natural Resources (0.5 - 4)	
PSYC 310	Biological Psychology (3)	
PSYC 311	Biological Psychology Laboratory (1)	
PSYC 495	Independent Studies in Psychology (1 - 3)	
PSYC 499	Experimental Offering in Psychology (0.5 - 4)	
Total Units:		18

¹must be transfer-level and must include one laboratory course in a physical science and one laboratory course in a biological science

The General Science Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See ARC graduation requirements.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- evaluate new and accepted ideas about the natural universe using scientific methods.

- analyze a wide variety of natural phenomena using basic definitions and fundamental theories of biological or physical sciences.
- apply appropriate quantitative and qualitative methods to interpret and analyze pertinent data.
- outline the basic concepts and fundamental theories of a natural science.
- articulate orally and/or in writing the importance of continuous examination and modification of accepted ideas as a fundamental element in the progress of science.
- discuss ethical components of scientific decision making and apply personal and social values within the process of decision making in scientific endeavors.

Physics (PHYS)

PHYS 310 Conceptual Physics

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 32 with a grade of "C" or better, or placement through the assessment process.
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC (UC credit limitations: PHYS 310 & 311 combined: maximum credit, one course. No credit if taken after PHYS 350 or 410)
General Education:	AA/AS Area IV; CSU Area B1; IGETC Area 5A
C-ID:	Part of C-ID PHYS 140
Catalog Date:	June 1, 2019

This course covers selected topics in motion, gravity, heat, sound, electricity, magnetism, light, and atomic and nuclear physics. It is designed for non-science majors and students who have not taken a course in physics.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation (such as Newton's Laws, energy conservation, or momentum conservation).
- analyze conceptual problems that require the application of basic physics concepts.
- solve simple mathematical problems that require the application of basic physics concepts.
- define common physics terms and physical laws.
- evaluate the pros and cons of topics such as nuclear power, release of greenhouse gases, and humanity's impact on the environment.

PHYS 311 Basic Physics

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 330 or 373 with a grade of "C" or better
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC (UC credit limitations: PHYS 310 & 311 combined: maximum credit, one course. No credit if taken after PHYS 350 or 410)

General Education:

AA/AS Area IV; CSU Area B1; IGETC Area 5A

Catalog Date:

June 1, 2019

This survey course emphasizes problem solving in physics. Topics include motion in one and two dimensions, forces, energy, and momentum. It is designed for science majors who plan to continue with PHYS 350 or 410.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- identify basic physical principles that apply in a particular situation (such as Newton's laws, energy conservation, or momentum conservation).
- evaluate conceptual problems that require the application of basic physics.
- solve problems that require the application of basic physics and mathematics.
- interpret the results of physics calculations.
- define common physics terms and physical laws.

PHYS 312 Conceptual Physics Laboratory

Units:

1

Hours:

54 hours LAB

Prerequisite:

None.

Corequisite:

PHYS 310

Advisory:

MATH 100, 104, or 132

Transferable:

CSU; UC

General Education:

AA/AS Area IV; CSU Area B3; IGETC Area 5C

C-ID:

Part of C-ID PHYS 140

Catalog Date:

June 1, 2019

This laboratory course provides hands-on observation activities and interpretation of data in a variety of experimental situations. Topics include motion, sound, light, heat, electricity, and magnetism.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- collect, analyze, and present experimental data.
- tabulate, graph, and interpret various experimental measurements and calculated results.
- apply dimensions and units correctly for various physical quantities.
- use instruments such as a protractor, mass balance, timer, ammeter, and voltmeter.
- write a well organized and complete lab report.

PHYS 350 General Physics

Units:

4

Hours:

54 hours LEC; 54 hours LAB

Prerequisite:

MATH 330 or 373 with a grade of "C" or better

Advisory:	PHYS 311; and eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC (UC credit limitation: PHYS 350, 360 & 410, 421, 431 combined: maximum credit, one series)
General Education:	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID:	C-ID PHYS 105; Part of C-ID PHYS 100S
Catalog Date:	June 1, 2019

This trigonometry-based physics course covers the mechanics of particles, rigid bodies, and fluids. It also covers mechanical waves, sound, heat, and thermodynamics. The PHYS 350/360 series is designed for biological science students, including those in pre-medical, pre-dental, agricultural, and forestry programs.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation (such as Newton's laws, energy conservation, or momentum conservation).
- analyze conceptual problems that require the application of physics.
- solve problems that require the application of physics and mathematics up through trigonometry.
- interpret the results of physics calculations.
- define common physics terms and physical laws.
- compose a well-organized and complete lab report.

PHYS 360 General Physics

Units:	4
Hours:	54 hours LEC; 54 hours LAB
Prerequisite:	PHYS 350 with a grade of "C" or better
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ELSW 340.
Transferable:	CSU; UC (UC credit limitation: PHYS 350, 360 & 410, 421, 431 combined: maximum credit, one series)
General Education:	CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID:	C-ID PHYS 110; Part of C-ID PHYS 100S
Catalog Date:	June 1, 2019

This trigonometry-based physics course covers electricity, magnetism, basic electric circuit theory, optics, wave behavior, and modern physics. The PHYS 350/360 series is designed for biological science students, including those in pre-medical, pre-dental, agricultural, and forestry programs.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation (such as Coulomb's law, Ohm's law, or charge conservation).
- analyze conceptual problems that require the application of physics.
- solve problems that require the application of physics and mathematics up through trigonometry.
- interpret the results of physics calculations.
- define common physics terms and physical laws.
- compose a well-organized and complete lab report.

PHYS 410 Mechanics of Solids and Fluids

Units:	5
Hours:	72 hours LEC; 54 hours LAB
Prerequisite:	MATH 400 with a grade of "C" or better
Corequisite:	MATH 401
Advisory:	PHYS 311; and eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU; UC (UC credit limitation: PHYS 350, 360 & 410, 421, 431 combined: maximum credit, one series)
General Education:	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
C-ID:	C-ID PHYS 205; Part of C-ID PHYS 200S
Catalog Date:	June 1, 2019

This calculus-based physics course covers the mechanics of particles, rigid bodies, and fluids. The PHYS 410, 421, 431 sequence is required for majors in physics, chemistry, or engineering.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation (such as Newton's laws, energy conservation and momentum conservation).
- evaluate conceptual problems requiring the application of mechanics.
- solve problems requiring the application of physics and mathematics up through calculus.
- interpret the results of physics calculations.
- define common physics terms and physical laws.
- compose a well-organized and complete lab report.

PHYS 421 Electricity and Magnetism

Units:	4
Hours:	54 hours LEC; 54 hours LAB
Prerequisite:	MATH 401 and PHYS 410 with grades of "C" or better
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ELSW 340.
Transferable:	CSU; UC (UC credit limitation: PHYS 350, 360 & 410, 421, 431 combined: maximum credit, one series)
C-ID:	C-ID PHYS 210; Part of C-ID PHYS 200S
Catalog Date:	June 1, 2019

This calculus-based physics course is an in-depth treatment of electricity and magnetism. It involves problem solving with an emphasis on physics problems that require integral calculus.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation (such as Coulomb's law, Ohm's law, and charge conservation).

- evaluate conceptual problems requiring the application of electricity and magnetism.
- solve problems requiring the application of physics and mathematics up through calculus.
- interpret the results of physics calculations.
- define basic physics terms and physical laws.
- compose a well-organized and complete lab report.

PHYS 431 Heat, Waves, Light and Modern Physics

Units:	4
Hours:	54 hours LEC; 54 hours LAB
Prerequisite:	MATH 401 and PHYS 410 with grades of "C" or better
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ELSW 340.
Transferable:	CSU; UC (UC credit limitation: PHYS 350, 360 & 410, 421, 431 combined: maximum credit, one series)
C-ID:	C-ID PHYS 215; Part of C-ID PHYS 200S
Catalog Date:	June 1, 2019

This calculus-based physics course explores the fundamental theories of thermodynamics, waves, optics, and modern physics. Topics include heat, temperature, kinetic theory, waves, sound, light reflection and refraction, optics, interference, diffraction, atomic theory, and nuclear physics.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- test the validity of a hypothesis using the scientific method.
- identify the basic physical principles that apply in a particular situation (such as interference, diffraction, or energy conservation).
- analyze conceptual problems that require the application of thermodynamics, wave mechanics, optics, and modern physics.
- solve problems requiring the application of physics and mathematics up through calculus.
- interpret the results of physics calculations.
- define common physics terms and physical laws.
- compose a well-organized and complete lab report.

PHYS 495 Independent Studies in Physics

Units:	1 - 3
Hours:	54 - 162 hours LAB
Prerequisite:	None.
Transferable:	CSU
Catalog Date:	June 1, 2019

Independent Study is an opportunity for the student to extend classroom experience in this subject, while working independently of a formal classroom situation. Independent study is an extension of work offered in a specific class in the college catalog. To be eligible for independent study, students must have completed the basic regular catalog course at American River College. They must also discuss the study with a professor in this subject and secure approval. Only one independent study for each catalog course will be allowed.

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