

Physics Major

Department of Physics, College of Science

Physics Teaching Major Composite Teaching Major in Physical Science

(Effective for students beginning degree Summer 2016 thru Spring 2017)

General Information

Admissions

1. New freshmen admitted to USU in good standing qualify for admission to these majors.
2. Transfer students from other institutions need a 2.2 transfer GPA and students transferring from other USU majors need a 2.0 total GPA for admission to these majors in good standing.
3. Incoming freshmen and transfer students wishing to complete either the **Physics Teaching** degree or the **Composite Teaching—Physical Science** degree must also apply for admission to the Secondary Teacher Education Program (STEP). Requirements for admissions to STEP include ACT minimum scores of 21 (Composite), 19 (Math), and 20 (English) and an overall GPA of 3.0. Courses relevant to either degree must be passed with at least a C grade. See the section **Secondary Teacher Education Program (STEP)** below for further details.

Degree Programs

The Physics Department offers a number of undergraduate degree options. There are three Bachelors of Science options: a **BS in Physics**, a **BS in Physics with Professional Emphasis**, and a **BS in Physics with Applied Emphasis**. There is also a **Bachelor of Arts in Physics** degree. In conjunction with the College of Education two teaching degrees are offered: a **BS Degree in Composite Teaching—Physical Science** and a **BS Degree in Physics Teaching** (which includes a Teaching Minor in another department). Additionally, **Physics Minor** and **Physics Teaching Minor** options are available to students working towards degrees outside of Physics.

All nonteaching degrees require a common core of courses, which includes the College of Science requirements (**MATH 1210, 1220**, and a one-year sequence in another science, see below); **MATH 2210** and **2250**, **PHYS 2210/2220** or **PHYS 2310/2320**, **PHYS 2215/2225**, **PHYS 2710, 3550, 3600, 3870**, and **4900**. Additional requirements are specified under each degree option below.

The degree programs of the department are constructed to be rigorous, yet flexible, and are intended to help students prepare for a broad range of careers. **Students in nonteaching tracks are encouraged to plan for the Professional Emphasis track, as it encompasses all courses required for graduate school.** Required course and laboratory work in these programs carefully balances theory and experiment. A formal research experience is integral to most departmental degrees, and undergraduates are encouraged to engage in research in the department early in their studies. For more information about undergraduate research opportunities, contact the physics academic advisor.

Academic Advisement

The academic advisor looks forward to helping students plan their courses of study. New students are strongly encouraged to meet with the advisor as soon as possible to begin the advisement process. All physics majors and minors should meet with the department academic advisor for assistance with course selection, program planning, and meeting graduation requirements (telephone: (435) 797-4021; e-mail: physics@usu.edu).

Career Opportunities

The **BA and BS degrees** (without emphasis) are designed for students that have a strong interest in physics, but have no intention of pursuing the study of physics or a related discipline at the advanced level. With the BA degree, students can pursue advanced work in the philosophy, history, or sociology of science; become technical writers; or pursue careers in finance, marketing, or patent and corporate law. Equipped with appropriate supplementary courses, some will enter medical, dental, and veterinary schools, while others will use their technical knowledge and quantitative abilities in management positions or in other aspects of business. Holders of the BS degree will share many of the same career opportunities, as well as have sufficient background to work as technical assistants in industrial or government laboratories.

The **BS in Physics with Professional Emphasis** and the **BS in Physics with Applied Emphasis** prepare students, whose ultimate intent is to establish careers in research, to continue the study of physics, astronomy, materials science, applied mathematics, and other related areas of physical science and engineering at the graduate level. Students terminating study with these degrees will have strong backgrounds in the fundamentals of physics used in industry or in research at national laboratories. Problem-solving skills developed in these programs will help make these degree holders attractive as employees in a wide variety of technical and business endeavors.

The **Physics Teaching** and **Composite Teaching—Physical Science** degrees provide licensure for students to teach physics and physical science in secondary schools in the State of Utah.

All Degrees

General University Requirements

A. Minimum University Requirements

| | |
|--|------|
| <input type="checkbox"/> Total credits | 120 |
| <input type="checkbox"/> Grade point average (most majors require higher GPA) ¹ | 2.00 |
| <input type="checkbox"/> Credits of C– or better | 100 |
| <input type="checkbox"/> Credits of upper-division courses (3000 or above) | 40 |
| <input type="checkbox"/> USU credits | 30 |
| (20 of which must be upper division, including 10 required by major) | |
| Completion of approved major program of study. (See department) | |
| <input type="checkbox"/> Credits in minor (if required by department) | 12 |
| <input type="checkbox"/> Credits in American Institutions (ECN 1500; HIST 1700, 2700, or 2710; POLS 1100; or USU 1300). | 3 |

B. University Studies Requirements

Approved University Studies courses and requirements are listed in the *General Catalog*. The most current catalog is <http://catalog.usu.edu>

¹ **Department of Physics Grade Policy.** Department of Physics policy states students may take *no more than one* Physics course to satisfy a major or minor requirement using the P-D-F option. All other courses used to satisfy such requirements must be completed with at least a C– grade. Both teaching majors require a grade of C or better in all major courses.

C. General Education Requirements (30-34 credits)

- Competency Requirements (9-10 credits)
- Communications Literacy (6 credits)
- ENGL 1010 (CL1)** (3 cr) (or satisfactory AP, CLEP, IBO, ACT, or SAT score) *and*
- ENGL 2010 (CL2)** (3 cr) (or satisfactory IBO score)
- Quantitative Literacy (QL) (3-4 credits)²
- MATH 1030 or 1050 or STAT 1040** or one **MATH** or **STAT** course requiring **MATH 1050** as a prerequisite (3-4 cr) (or satisfactory AP, CLEP, IBO, ACT, or SAT score)
- Breadth Requirements (18-20 credits)
- Select at least one approved course from each of the following six categories: **American Institutions (BAI)**, **Creative Arts (BCA)**, **Humanities (BHU)**, **Life Sciences (BLS)**,³ **Physical Sciences (BPS)**,⁴ and **Social Sciences (BSS)**.
- Exploration Requirement (3-4 credits)
- Choose an additional class from one of the following General Education categories: QL, BAI, BCA, BHU, BLS, BPS, or BSS.

D. Depth Education Requirements

- Communications Intensive (CI) (2 courses)
- For most students, courses taken for the major will meet this requirement.
- Quantitative Intensive (QI) (1 course)
- For most students, a course taken for the major will meet this requirement.
- Depth Course Requirements (4 credits minimum, including 2 credits minimum completed in *each* of two courses)
- Complete at least 2 credits in approved 3000-level or above courses from each of the following two categories: **Humanities and Creative Arts (DHA)** and **Social Sciences (DSS)**.⁵

E. Changes in Graduation/Catalog Requirements

Students who can complete a baccalaureate degree within seven years of enrollment at USU can qualify for graduation by meeting (1) the General Education/ University Studies requirements in effect when they initially enrolled and (2) the major requirements in effect when they officially declared their major, even though there may have been changes in General Education/University Studies and major requirements since that time.

Students who have not completed the baccalaureate requirements within seven years of their initial enrollment at USU must have their General Education/ University Studies and major requirements evaluated and approved by their department head and dean.

F. Undergraduate Course Expiration Policy

Coursework (including transfer credit) that is (i) more than 10 years old and (ii) is required by the major may be disallowed by the student's department. Students will have an opportunity to revalidate coursework that is disallowed.

Physics Degrees

Core Coursework – All Physics BS and BA Degrees (49 credits)

- A. College of Science Requirements (16 credits)** Credits
- MATH 1210** (4 cr) and **1220** (4 cr) 8
- Choose *one* of the following sequences:
BIOL 1610 (4 cr) and **1620 (BLS)** (4 cr) *or*
CHEM 1210 (4 cr) and **1220 (BPS)** (4 cr) *or*
GEO 1110 (BPS) (3 cr), **1115** (1 cr) and **3200** (4 cr) 8

² Required MATH courses fulfill the QL Requirement.

³ Students in the Composite Teaching Major in Physical Science fulfill the BLS requirement by taking **BIOL 1010**, which is required. Students in the other physics majors may fulfill the BLS requirement by selecting the **BIOL 1610, 1620** sequence under the General Science requirements.

⁴ Students with majors in the Physics Department may fulfill the BPS requirement by selecting the **CHEM 1210, 1220** or the **GEO 1110, 1115, 3200** sequence under the College of Science requirements. **PHYS 2210** or **2310** also fulfill this requirement.

⁵ Students going into the Sec Ed program fulfill their DSS with **SCED 3210**.

- B. Required Physics Courses (26 credits)** Credit
- PHYS 2210 or 2310 (BPS/QI)** Physics I 4
- PHYS 2215** Physics Lab I 1
- PHYS 2220 or 2320 (BPS/QI)** Physics II 4
- PHYS 2225** Physics Lab II 1
- PHYS 2500** Introduction to Computer Methods in Physics⁶ 2
- PHYS 2710** Introductory Modern Physics 3
- PHYS 3550** Intermediate Classical Mechanics 3
- PHYS 3600** Electromagnetism I 3
- PHYS 3870 (CI)** Intermediate Physics Laboratory 3
- PHYS 4900 (CI)** Research in Physics 2

C. Required Mathematics Courses (7 credits)

- MATH 2210 (QI)** Multivariable Calculus (F, Sp, Su) 3
- MATH 2250 (QI)** Lin. Algebra and Diff. Eqns. (Sp, Su) 4

BS Degree in Physics (61 credits)

A. Required Core Coursework (49 credits)

- B. Required Physics Courses (6 credits)** Credits
- PHYS 3700** Thermal Physics *or* **PHYS 4650** Optics I 3
- PHYS 3710** Intermediate Modern Physics 3

C. Elective Physics Courses (6 credits)

- Select 6 additional credits from PHYS courses at the 3500 level and above (*not* to include PHYS courses designated as University Studies depth courses nor PHYS 5800).

BS Degree in Physics with Professional Emphasis (75 credits)

The Professional Emphasis is recommended for students preparing for graduate work in physics, astronomy, or a closely related discipline.

A. Required Core Coursework (49 credits)

- B. Required Physics Courses (26 credits)** Credits
- PHYS 3700** Thermal Physics 3
- PHYS 3710** Intermediate Modern Physics 3
- PHYS 3750** Foundations of Wave Phenomena 3
- PHYS 3880 (CI)** Advanced Physics Laboratory 3
- PHYS 4600** Electromagnetism II 3
- PHYS 4650** Optics I 3
- PHYS 4700** Quantum Mechanics I 3
- PHYS 4710** Quantum Mechanics II 3
- PHYS 4900 (CI)** Research in Physics 2

BS Degree in Physics with Applied Emphasis (70 credits)

The Applied Emphasis is recommended for students preparing for graduate work in applied physics, engineering physics, materials science, or an interdisciplinary area such as biophysics, medical physics, geophysics, or chemical physics.

A. Required Core Coursework (49 credits)

- B. Required Physics Courses (9 credits)** Credits
- PHYS 3700** Thermal Physics 3
- PHYS 3880 (CI)** Advanced Physics Laboratory 3
- PHYS 4650** Optics I⁷ 3

C. Elective Technical Courses (12 credits)

- Select 12 credits from courses in other technical departments at the 3000 level and above (*not* to include courses designated as University Studies depth courses) with a coherent theme. Selected courses require approval of the Physics Department.

⁶ **CS 1400/1410** (4 credits) may be substituted for **PHYS 2500**.

⁷ Students with emphasis in geophysics may replace **PHYS 4650** with **PHYS 3750**.

BA Degree in Physics (77 credits)

A. Required Core Coursework (49 credits)

B. Elective Physics Courses (6 credits)

Select 6 additional credits from PHYS courses at the 3500 level and above (*not* to include PHYS courses designated as University Studies depth courses).

C. Required Philosophy Courses (6 credits)

| | Credits |
|---|---------|
| <input type="checkbox"/> PHIL 4310 (DHA) Philosophy of Science (Sp) | 3 |
| <input type="checkbox"/> PHIL 4320 (DHA) History of Scientific Thought. | 3 |

D. Required Language Courses (16 credits)

Two years' training or equivalent in a foreign language approved by the Languages, Philosophy, and Speech Communication Department. For further information, see the *General Catalog*.

Physics Minor (20 credits)

Students majoring in other departments may earn a physics minor by completing the following courses. A minor is not required for students majoring in physics.

A. Required Physics Courses (10 credits)

| | Credits |
|---|---------|
| <input type="checkbox"/> PHYS 2210 or 2310 (BPS/QI) Physics I. | 4 |
| <input type="checkbox"/> PHYS 2215 Physics Lab I. | 1 |
| <input type="checkbox"/> PHYS 2220 or 2320 (BPS/QI) Physics II. | 4 |
| <input type="checkbox"/> PHYS 2225 Physics Lab II. | 1 |

B. Physics Electives (10 credits)

Select 10 additional credits from PHYS 2500, 2710, and/or PHYS courses at the 3000 level and above (*not* to include PHYS courses designated as University Studies depth courses). (MATH 1220 is a prerequisite for PHYS 2710. Only 1 credit of PHYS 5800 may be used to fulfill this requirement.

D. General Science Requirements (16 credits)

From the General Science Requirements list below, select one full science series (2 courses) and the first course of the other two series not chosen, for a total of 16 credits.

BIOL 1610 (4 cr), 1620 (BLS) (4 cr)
CHEM 1210 (4 cr), 1220 (BPS) (4 cr)
GEOL 1110/1115 (BPS) (3+1 cr), 3200 (4 cr)

E. Teaching Minor

Students must complete the requirements for a Teaching Minor in a department other than Physics. The particular department is of the student's choosing.

F. Secondary Teacher Education Program (STEP) (35 credits)

Students with a Teaching major in Physics must complete the requirements for the STEP program. Admission requirements for STEP are listed below.

A minimum GPA of 2.75 in PHYS 2210 (or 2310), 2215, 2220 (or 2320) and 2225 is required.

Prior to student teaching, all USU teacher education candidates are required to take and pass the Praxis content exam approved by the Utah State Office of Education in their major content area.

BS Degree in Composite Teaching—Physical Science

(91-92 credits) (2.75 GPA)

This degree is available through the Physics Department or the Chemistry and Biochemistry Department. Courses relevant to the Major must be passed with at least a C grade.

A. Required Physics Courses (16 credits)

| | Credits |
|---|---------|
| <input type="checkbox"/> PHYS 1040 (BPS) Introductory Astronomy. | 3 |
| <input type="checkbox"/> PHYS 1080/ USU 1360 (BPS) Intelligent Life in the Universe | 3 |
| <input type="checkbox"/> PHYS 2210 or 2310 (BPS/QI) Physics I. | 4 |
| <input type="checkbox"/> PHYS 2215 Physics Lab I. | 1 |
| <input type="checkbox"/> PHYS 2220 or 2320 (BPS/QI) Physics II. | 4 |
| <input type="checkbox"/> PHYS 2225 Physics Lab II. | 1 |

B. Elective Physics Courses (5 credits)

Select 5 additional credits from PHYS 2500, 2710, and/or PHYS courses at the 3000 level and above. May include research in physics education.

C. Required Math/Stats Courses (11 credits)

| | Credits |
|---|---------|
| <input type="checkbox"/> MATH 1210 (QL) Calculus I (F, Sp, Su) | 4 |
| <input type="checkbox"/> MATH 1220 (QL) Calculus II (F, Sp, Su) | 4 |
| <input type="checkbox"/> STAT 3000 (QI) Statistics for Scientists (F, Sp, Su) | 3 |

D. Required Chemistry Courses (14-15 credits)

| | |
|--|--------|
| <input type="checkbox"/> CHEM 1210 Principles of Chemistry I (F, Sp). | 4 |
| <input type="checkbox"/> CHEM 1215 Chemical Principles Laboratory I (F, Sp) | 1 |
| <input type="checkbox"/> CHEM 1220 (BPS) Principles of Chemistry II (F, Sp, Su). | 4 |
| <input type="checkbox"/> CHEM 1225 Chemical Principles Laboratory II (F, Sp) | 1 |
| <input type="checkbox"/> CHEM 2300 Principles of Organic Chemistry (F) (3 cr) or CHEM 2310 Organic Chemistry I (F) (4 cr) | 3 or 4 |
| <input type="checkbox"/> CHEM 2315 Organic Chemistry Laboratory I (F). | 1 |

E. Required Science Courses (9 credits)

| | |
|---|---|
| <input type="checkbox"/> BIOL 1010 (BLS) Biology and the Citizen (F, Sp, Su). | 3 |
| <input type="checkbox"/> GEO 1110 (BPS) (3 cr) and GEO 1115 (1 cr) The Dynamic Earth: Physical Geology (F, Sp) | 4 |
| <input type="checkbox"/> PSC 2000 (BPS) The Atmosphere and Weather (F) | 3 |

F. Secondary Teacher Education Program (STEP) (35 credits)

Students with a Composite Teaching major in Physical Science must complete the requirements for the STEP program. Admission requirements for STEP are listed below.

Prior to student teaching, all USU teacher education candidates are required to take and pass the Praxis content exam approved by the Utah State Office of Education in their major content area.

Physics Teaching Degrees

BS Degree in Physics Teaching (with a Teaching Minor)

(96 credits minimum, plus the credits required by the teaching minor)

(3.0 GPA required for Sec. Ed. program)

Courses relevant to the major and minor must be passed with at least a C grade.

A. Required Physics Courses (23 credits)

| | Credits |
|--|---------|
| <input type="checkbox"/> PHYS 1040 (BPS) Introductory Astronomy. | 3 |
| <input type="checkbox"/> PHYS 2210 or 2310 (BPS/QI) Physics I. | 4 |
| <input type="checkbox"/> PHYS 2215 Physics Lab I. | 1 |
| <input type="checkbox"/> PHYS 2220 or 2320 (BPS/QI) Physics II. | 4 |
| <input type="checkbox"/> PHYS 2225 Physics Lab II. | 1 |
| <input type="checkbox"/> PHYS 2500 Introduction to Computer Methods in Physics | 2 |
| <input type="checkbox"/> PHYS 2710 Introductory Modern Physics | 3 |
| <input type="checkbox"/> PHYS 3710 Intermediate Modern Physics | 3 |
| <input type="checkbox"/> PHYS 3870 (CI) Intermediate Laboratory I. | 2 |

B. Elective Physics Courses (5 credits)

Select 5 additional credits from PHYS courses at the 3000 level and above. USU Depth courses, as well as research in physics education may be included.

C. Required Mathematics Courses (15 credits)

| | Credits |
|---|---------|
| <input type="checkbox"/> MATH 1210 (QL) Calculus I (F, Sp, Su). | 4 |
| <input type="checkbox"/> MATH 1220 (QL) Calculus II (F, Sp, Su) | 4 |
| <input type="checkbox"/> MATH 2250 (QI) Lin. Algebra and Diff. Eqns. (Sp, Su) | 4 |
| <input type="checkbox"/> STAT 3000 (QI) Statistics for Scientists (F, Sp, Su) | 3 |

Teaching Minor in Physics (22 credits)

Courses relevant to this minor must be passed with at least a C grade.

| A. Required Physics Courses (13 credits) | Credits |
|---|---------|
| <input type="checkbox"/> PHYS 1040 (BPS) Introductory Astronomy | 3 |
| <input type="checkbox"/> PHYS 2210 or 2310 (BPS/QI) Physics I | 4 |
| <input type="checkbox"/> PHYS 2215 Physics Lab I | 1 |
| <input type="checkbox"/> PHYS 2220 or 2320 (BPS/QI) Physics II | 4 |
| <input type="checkbox"/> PHYS 2225 Physics Lab II | 1 |

B. Physics Electives (9 credits)

Select 9 additional credits from PHYS 2500, 2710, and/or PHYS courses at the 3000 level and above. USU Depth courses may not be included. (MATH 1220 is a prerequisite for PHYS 2710.)

A grade of C or better is required for the Teaching Minor.

C. Secondary Teacher Education Program (STEP) (35 credits)

The Teaching Minor in Physics requires completion of the STEP program. Admission requirements for STEP are listed below.

Secondary Teacher Education Program (STEP) (35 credits)

Prior to enrolling in this program, students must be approved for admission to STEP by the Emma Eccles Jones College of Education and Human Services. Students must have a **minimum of 60 credits**, an **overall GPA of 3.0**, and **minimum ACT scores of 21 (Composite), 19 (Math), and 20 (English)**

Students must meet the Department of Physics GPA standards, noted previously, for each option. For information on other criteria that must be met for acceptance, students should consult with advisors in the Secondary Education Program, School of Teacher Education and Leadership (TEAL). **A grade of C or better is required in all STEP courses.**

| A. Level 1 (11 credits) | Credits |
|---|---------|
| <input type="checkbox"/> SCED 3100 Motivation and Classroom Management (F, Sp) | 3 |
| <input type="checkbox"/> SCED 3210 (CI/DSS) Educational and Multicultural Foundations (F, Sp) | 3 |
| <input type="checkbox"/> SCED 3300 Clinical Experience I (40 hours minimum) (F) | 1 |
| <input type="checkbox"/> SCED 3400 Teaching Science I (Fall only) ⁸ | 3 |
| <input type="checkbox"/> ITLS 4015 Technology Tools and Integration for Teachers (F,Sp) | 1 |

B. Level 2 (12 credits)

| | |
|--|---|
| <input type="checkbox"/> SCED 4200 (CI) Reading, Writing, and Technology (F, Sp) | 3 |
| <input type="checkbox"/> SCED 4210 Cognition and Eval. of Student Learning (F, Sp) | 3 |
| <input type="checkbox"/> SCED 4300 Clinical Experience II (40 hours min.) (Sp) | 1 |
| <input type="checkbox"/> SCED 4400 Teaching Science II (Sp only) ⁸ | 3 |
| <input type="checkbox"/> SPED 4000 Education of Exceptional Individuals (may be taken anytime) (F, Sp, Su) | 2 |

C. Level 3 (12 credits)

| | |
|--|----|
| <input type="checkbox"/> SCED 5500 Student Teaching Seminar (2 weeks) (F, Sp) | 2 |
| <input type="checkbox"/> SCED 5630 Student Teaching in Secondary Schools (13 weeks, full-time) (F, Sp) | 10 |

⁸The Teaching Science I and II courses (SCED 3400 and 4400) are *only* taught once per year. Therefore, it is important for students to consult with their advisor to schedule these courses in the correct sequence into their plan of study.

Other Information

Final Examination

Graduating seniors *may* be required to take a final examination covering the content of their major. **The exam will *not* affect the graduation status of students in any way**, but rather is an assessment tool. The combined results of all the examinations will be used by the department to judge the effectiveness of its curriculum, not the student.

Requirement Changes

Graduation requirements shown on this sheet are subject to change. Students should check with the departmental advisor concerning possible changes.

Materials for Persons with Disabilities

This requirement sheet is available in alternate formats upon request to the USU Disability Resource Center.

Contact Information

Physics Department
Science Engineering Research 250
Utah State University
4415 Old Main Hill
Logan UT 84322-4415

Telephone: (435) 797-2857;
Email: physics@usu.edu
Web: <http://www.physics.usu.edu>