Utah State University

Department of Physics
College of Science

Physics Major

Physics Teaching Major
Composite Teaching Major in Physical Science

Published April 2007 **Effective for students beginning degree Summer Sem. 2007 thru Spring Sem. 2008**

Admission Requirements For These Majors

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. Students wishing to complete the Teaching Major in Physics or the Composite Teaching Major in Physical Science must also apply for admission to the secondary teacher education program. See the section **Secondary Teacher Education Program (STEP).**

The Program

The Department of Physics offers the following degree options: Bachelor of Arts in Physics, Bachelor of Science in Physics, Bachelor of Science in Physics with a Professional Emphasis, Bachelor of Science in Physics with an Applied Emphasis, Bachelor of Science in Physics Teaching, and Bachelor of Science in Composite Teaching—Physical Science (available through either the Physics Department or the Chemistry and Biochemistry Department). Except for the two teaching majors, all 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; PHYS 2210 and 2220 (preferred), or PHYS 2110 and 2120; 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. 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.

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.

Academic Advisement

All physics majors and minors should contact the department academic advisor for assistance with course selection, program planning, and meeting graduation requirements (tel. 797-4021 or e-mail physics@cc.usu.edu).

Career Opportunities

The BA and BS degrees (without emphasis) are designed for students having a strong interest in physics, but having 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 with Professional Emphasis and the BS 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 Teaching major in Physics and the Composite Teaching major in Physical Science provide licensure for students to teach physics and physical science in secondary schools in the State of Utah.

Degrees and Programs Offered Through This Department

Physics: Bachelor of Science (BS), Bachelor of Arts (BA), Master of Science (MS), Doctor of Philosophy (PhD)

Physics Teaching: BS

Composite Teaching—Physical Science (Physics): BS

Graduation Requirements: BA* and all BS Degrees in Physics (not including Teaching)

Minimum University Requirements**

Total credits	120
Grade point average (most majors require higher GPA)**	2.00 GPA
Credits of *C*- or better	100
Credits of upper-division courses (#3000 or above)	40
USU credits	30
(20 of which must be upper division, including 10 required by major)	
Completion of approved major program of study	See department
Credits in minor (if required by department)	12
Credits in American Institutions (ECON 1500; HIST 1700, 2700, or 2710; POLS 1100; or USU 1300)	3
University Studies requirements	See next page

*A BA degree requires foreign language training. For further information, see the *General Catalog*.

****Department of Physics Grade Policy.** Department of Physics policy states that 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, and the total GPA in all required departmental courses must be at least 2.3. The Teaching Major in Physics, the Teaching Minor in Physics, and the Composite Teaching Major in Physical Science require a 2.75 minimum GPA in Physics courses and a 2.75 minimum overall GPA for graduation.

University Studies Requirements for Physics Majors

Note: Approved University Studies courses and requirements are listed in the back section of each semester's *Schedule of Classes*.

General Education Requirements (27-28 credits)

Competency Requirements (9-10 credits)

Communications Literacy (CL1 and CL2) (6 credits)

ENGL 1010 (CL1) (3 credits) or satisfactory AP, CLEP, IBO, ACT, or SAT score

AND

ENGL 2010 (CL2) (3 credits) or satisfactory IBO score

Quantitative Literacy (QL) (3-4 credits)[1]

MATH 1030 or 1050 or STAT 1040 (3-4 credits)

OR

One MATH or STAT course requiring MATH 1050 as a prerequisite

OR

Satisfactory AP, CLEP, IBO, ACT, or SAT score

Computer and Information Literacy (0 credits)

Passing grade on six computer and information literacy related examinations.

Breadth Requirements (18 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)[2], Physical Sciences (BPS)[3],** and **Social Sciences (BSS)**. At least two of the six breadth courses must be University Studies courses with a **USU prefix** (excluding USU 1000, 1010, 1100, 3330, 4900, and 6900). (CLEP or AP credit may be used.)

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)

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)**.

[1]Courses in any of the physics majors will fulfill the Quantitative Literacy Requirement.

[2]Students in the Composite Teaching Major in Physical Science will fulfill the Life Sciences requirement by taking BIOL 1010, which is required. Students in the other physics majors may fulfill the Life Sciences requirement by selecting the BIOL 1610, 1620 sequence under the General Science requirements.

[3]Students with majors in the Physics Department may fulfill the Physical Sciences requirement by selecting the CHEM 1210, 1220 *or* the GEO 1110, 3200 sequence under the General Science requirements. PHYS 2220 or 2120, if selected under the Common Core Coursework, will also fulfill this requirement.

Minimum College of Science Requirements (16 credits)

BA and BS degree candidates in Physics must complete the following coursework or equivalent to fulfill the College of Science minimum requirements.

1. MATH 1210 (4 cr), 1220 (4 cr) 8
2. Choose *one* of the following three sequences:
   BIOL 1610[6] (4 cr), 1620[6] (BLS) (4 cr) 8
   (formerly BIOL 1210 and 1220)
   CHEM 1210 (4 cr), 1220 (BPS) (4 cr). 8
   GEO 1110[6] (BPS) (4 cr), 3200 (4 cr) 8
   (formerly GEOL 1150)

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.

Undergraduate Course Expiration Policy

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

Required Common Core Coursework for BA and all BS Degrees in Physics (not including Teaching) (42 credits)

A. College of Science Requirements (16 credits)

B. Required Physics Courses (23 credits) **Credits**

- ☐ **PHYS 2210 (QI)** General Physics—Science and Engineering I (4 cr) **and**
- ☐ **PHYS 2220 (BPS/QI)** General Physics—Science and Engineering II (4 cr) 8

OR

- ☐ **PHYS 2110** The Physics of Living Systems I (4 cr) **and**
- ☐ **PHYS 2120 (BPS)** The Physics of Living Systems II (4 cr) 8
  (PHYS 2210 and 2220 are preferred.)
- ☐ **PHYS 2500** Introduction to Computer Methods in Physics 2
- ☐ **PHYS 2710** Introductory Modern Physics 3
- ☐ **PHYS 3550** Intermediate Classical Mechanics 3
- ☐ **PHYS 3600** Intermediate Electromagnetism (3 cr) **or**
- ☐ **ECE 3870** Electromagnetics I (Sp) (3 cr) 3
- ☐ **PHYS 3870 (CI)** Intermediate Laboratory I. 2
- ☐ **PHYS 4900 (CI)** Research in Physics 2

C. Required Mathematics Course (3 credits)

- ☐ **MATH 2210 (QI)** Multivariable Calculus (F,Sp,Su) 3

Required Coursework for BA Degree in Physics (74 credits)

A. Required Common Core Coursework (42 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 Mathematics Course (4 credits)

- ☐ **MATH 2250 (QI)** Linear Algebra and Differential Equations (F,Sp,Su) 4

D. Required Philosophy Courses (6 credits)

- ☐ **PHIL 4310 (DHA)** Philosophy of Science (Sp). 3
- ☐ **PHIL 4320 (DHA)** History of Scientific Thought 3

E. Required Language Courses (16 credits)

Two years' training or equivalent in a foreign language approved by the Languages, Philosophy, and Speech Communication Department.

Required Coursework for BS Degree in Physics (57 credits)

A. Required Common Core Coursework (42 credits)

B. Required Physics Courses (6 credits) **Credits**

- ☐ **PHYS 3700** Thermal Physics (3 cr) **or**
- ☐ **PHYS 4650** Optics I (3 cr). 3
- ☐ **PHYS 3710** Intermediate Modern Physics 3

C. Elective Physics Courses (5 credits)
Select 5 additional credits from PHYS courses at the 3500 level and above (*not* to include PHYS courses designated as University Studies depth courses).

D. Required Mathematics Course (4 credits) **Credits**
- ☐ **MATH 2250 (QI)** Linear Algebra and Differential Equations (F,Sp,Su) 4

Required Coursework for BS Degree in Physics with Professional Emphasis (71 credits)

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

A. Required Common Core Coursework (42 credits)

B. Required Physics Courses (25 credits) **Credits**
- ☐ **PHYS 3700** Thermal Physics 3
- ☐ **PHYS 3710** Intermediate Modern Physics 3
- ☐ **PHYS 3750** Foundations of Wave Phenomena 3
- ☐ **PHYS 3880 (CI)** Intermediate Laboratory II 2
- ☐ **PHYS 4600** Advanced Electromagnetism 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

C. Required Mathematics Course (4 credits)
- ☐ **MATH 2250 (QI)** Linear Algebra and Differential Equations (F,Sp,Su) 4

Required Coursework for BS Degree in Physics with Applied Emphasis (66 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 Common Core Coursework (42 credits)

B. Required Physics Courses (8 credits) **Credits**
- ☐ **PHYS 3700** Thermal Physics 3
- ☐ **PHYS 3880 (CI)** Intermediate Laboratory II 2
- ☐ **PHYS 4650** Optics I 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.

D. Required Mathematics Course (4 credits)
- ☐ **MATH 2250 (QI)** Linear Algebra and Differential Equations (F,Sp,Su) 4

Mathematics and Physics Dual Major Option

By fulfilling *all degree requirements* for *any two* separate majors, it is possible for a student to receive a diploma having two majors listed. Because most physics majors are required to complete a minimum of 14 credits in mathematics courses, many students elect to complete the requirements for a BS degree in mathematics, as well as the requirements for their physics degree.

Physics Minor (18 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 (8 credits) **Credits**
- ☐ **PHYS 2210 (QI)** General Physics—Science and Engineering I (4 cr) **and**
- ☐ **PHYS 2220 (BPS/QI)** General Physics—Science and Engineering II (4 cr) 8

OR
- ☐ **PHYS 2110** The Physics of Living Systems I (4 cr) **and**
- ☐ **PHYS 2120 (BPS)** The Physics of Living Systems II (4 cr) 8
  (PHYS 2210 and 2220 are preferred.)

B. Physics Electives (10 credits)
Select 10 additional credits from PHYS courses at the 2500 level and above (*not* to include PHYS courses designated as University Studies depth courses). (MATH 1220 is a prerequisite for PHYS 2710.)

Required Coursework for BS Degree in Physics Teaching (94 credits minimum) (2.75 GPA)

A. Required Physics Courses (21 credits) **Credits**
- ☐ **PHYS 1040 (BPS)**[6] Introductory Astronomy 3
  (formerly PHYX 1000)
- ☐ **PHYS 2210 (QI)** General Physics—Science and Engineering I (4 cr) **and**
- ☐ **PHYS 2220 (BPS/QI)** General Physics—Science and Engineering II (4 cr) 8

OR
- ☐ **PHYS 2110** The Physics of Living Systems I (4 cr) **and**
- ☐ **PHYS 2120 (BPS)** The Physics of Living Systems II (4 cr) 8
  (PHYS 2210 and 2220 are preferred.)
- ☐ **PHYS 2500** Introduction to Computer Methods in Physics 2
- ☐ **PHYS 2710** Introductory Modern Physics 3
- ☐ **PHYS 3710** Intermediate Modern Physics 3
- ☐ **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. May include research in physics education.

C. Required Mathematics Courses (15 credits)
- ☐ **MATH 1210 (QL)** Calculus I (F,Sp,Su) 4
- ☐ **MATH 1220 (QL)** Calculus II (F,Sp,Su) 4
- ☐ **MATH 2250 (QI)** Linear Algebra and Differential Equations (F,Sp,Su) 4
- ☐ **STAT 3000 (QI)** Statistics for Scientists (F,Sp,Su) 3

D. General Science Requirements (18 credits minimum)
- ☐ **SCI 4300** Science in Society (F,Sp) 2

Choose *one* of the following three sequences:

BIOL 1610[6] (4 cr), 1620[6] (BLS) (4 cr) 8
(formerly BIOL 1210 and 1220)
CHEM 1210 (4 cr), 1220 (BPS) (4 cr). 8
GEO 1110[6] (BPS) (4 cr), 3200 (4 cr) 8
(formerly GEOL 1150)

Select a minimum of 8 credits, 4 credits minimum in each of the two areas not covered by the sequence chosen above.

E. Secondary Teacher Education Program (STEP) (35 credits)
Students with a Teaching Major in Physics must complete the requirements for the STEP, as listed on the next page. Admission to the STEP with this major requires a minimum GPA of 2.75 in either PHYS 2110 and 2120, or PHYS 2210 and 2220, in addition to Department of Secondary Education requirements.

Note: Beginning in 2006, all USU teacher education candidates will be required to take and pass the content exam approved by the Utah State Office of Education in their major content area prior to student teaching.

Required Coursework for BS Degree in Composite Teaching—Physical Science (91-92 credits) (2.75 GPA)

This degree is available through the Chemistry and Biochemistry Department or the Physics Department.

A. Required Physics Courses (14 credits) **Credits**
- ☐ **PHYS 1040 (BPS)**[6] Introductory Astronomy 3
  (formerly PHYX 1000)
- ☐ **PHYS 1080 (BPS)**[4,6] Intelligent Life in the Universe (3 cr) **or**
  (formerly PHYX 1030)
- ☐ **PHYS 3030 (QI)** The Universe (3 cr) 3
- ☐ **PHYS 2210 (QI)** General Physics—Science and Engineering I (4 cr) **and**
- ☐ **PHYS 2220 (BPS/QI)** General Physics—Science and Engineering II (4 cr) 8

OR
- ☐ **PHYS 2110** The Physics of Living Systems I (4 cr) **and**
- ☐ **PHYS 2120 (BPS)** The Physics of Living Systems II (4 cr) 8
  (PHYS 2210 and 2220 are preferred.)

B. Elective Physics Courses (5 credits)

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

C. Required Mathematics and Statistics Courses (11 credits) **Credits**

- ☐ **MATH 1210 (QL)** Calculus I (F,Sp,Su) 4
- ☐ **MATH 1220 (QL)** Calculus II (F,Sp,Su) 4
- ☐ **STAT 3000 (QI)** Statistics for Scientists (F,Sp,Su) 3

D. Required Chemistry Courses (14-15 credits)

- ☐ **CHEM 1210** Principles of Chemistry I (F,Sp) 4
- ☐ **CHEM 1215**[6] Chemical Principles Laboratory I (F,Sp). 1
  (formerly CHEM 1230)
- ☐ **CHEM 1220 (BPS)** Principles of Chemistry II (F,Sp,Su). 4
- ☐ **CHEM 1225**[6] Chemical Principles Laboratory II (F,Sp) 1
  (formerly CHEM 1240)
- ☐ **CHEM 2300** Principles of Organic Chemistry (F) (3 cr) **or**
- ☐ **CHEM 2310** Organic Chemistry I (F) (4 cr) . . . . . 3 or 4
- ☐ **CHEM 2315**[6] Organic Chemistry Laboratory I (F) 1
  (formerly CHEM 2330)

E. Required Science Courses (12 credits)

- ☐ **BIOL 1010 (BLS)** Biology and the Citizen (F,Sp,Su) 3
- ☐ **GEO 1110 (BPS)**[6] The Dynamic Earth: Physical Geology (F,Sp) . . 4
  (formerly GEOL 1150)
- ☐ **BMET 2000 (BPS)** The Atmosphere and Weather (F,Sp) 3
- ☐ **SCI 4300** Science in Society (F,Sp) 2

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

Students with a Composite Teaching major in Physical Science must complete the requirements for the STEP, as listed below. Admission to the STEP with this major requires a minimum GPA of 2.75 in either PHYS 2110 and 2120, or PHYS 2210 and 2220; and a minimum GPA of 2.75 in CHEM 1210, 1215, 1220, 1225; in addition to Department of Secondary Education requirements.

Students who may wish to teach Integrated Science at the middle or junior high school level should talk to their advisor about completing the courses necessary for an Integrated Science endorsement.

Note: Beginning in 2006, all USU teacher education candidates will be required to take and pass the content exam approved by the Utah State Office of Education in their major content area prior to student teaching.

[4]PHYS 1080 is sometimes listed as USU 1360, IPS: Intelligent Life in the Universe.

Teaching Minor in Physics (19-20 credits)

A. Required Physics Courses (11 credits) **Credits**

- ☐ **PHYS 1040 (BPS)**[6] Introductory Astronomy 3
  (formerly PHYX 1000)
- ☐ **PHYS 2210 (QI)** General Physics—Science and Engineering I (4 cr) **and**
- ☐ **PHYS 2220 (BPS/QI)** General Physics—Science and Engineering II (4 cr) 8

OR

- ☐ **PHYS 2110** The Physics of Living Systems I (4 cr) **and**
- ☐ **PHYS 2120 (BPS)** The Physics of Living Systems II (4 cr) 8

(PHYS 2210 and 2220 are preferred.)

B. Physics Electives (6 credits)

Select 6 additional credits from PHYS courses at the 2500 level and above. (MATH 1220 is a prerequisite for PHYS 2710.)

C. Other Science Course (2-3 credits)

- ☐ **SCI 4300** Science in Society (F,Sp) (2 cr) **or**
- ☐ Any science course outside of physics, not required by the student's major (if SCI 4300 is required by student's major) (2-3 cr) . . . . . 2 or 3

In addition to the courses in sections *A*, *B*, and *C*, the Teaching Minor in Physics requires completion of the **Secondary Teacher Education Program (STEP),** as listed below. Admission to the STEP with this minor requires a minimum GPA of 2.75 in either PHYS 2110 and 2120, ***or*** PHYS 2210 and p; in addition to Department of Secondary Education requirements.

Secondary Teacher Education Program (STEP) (35 credits)

Prior to enrolling in these courses, students must be approved for admission to the STEP by the College of Education and Human Services. Students must have a minimum of 60 credits and a total GPA of 2.75, and must meet the Department of Physics GPA standards noted above for each option. For information on other criteria that must be met for acceptance, students should consult with advisors in the Department of Secondary Education.

A. Level 1 (11 credits) **Credits**

- ☐ **SCED 3100** Motivation and Classroom Management (F,Sp) 3
- ☐ **SCED 3210 (CI/DSS)** Educational and Multicultural Foundations (F,Sp) 3
- ☐ **SCED 3300** Clinical Experience I (40 hours minimum) (F,Sp) 1
- ☐ **SCED 3400**[5] Teaching Science I (F,Sp) 3
- ☐ **INST 3500** Technology Tools for Secondary Teachers (F,Sp,Su) . . 1

B. Level 2 (12 credits)

- ☐ **SCED 4200 (CI)** Reading, Writing, and Technology (F,Sp) 3
- ☐ **SCED 4210** Cognition and Evaluation of Student Learning (F,Sp) . . 3
- ☐ **SCED 4300** Clinical Experience II (40 hours minimum) (F,Sp) . . . 1
- ☐ **SCED 4400**[5] Teaching Science II (F,Sp) 3
- ☐ **SPED 4000** Education of Exceptional Individuals (may be taken anytime) (F,Sp,Su) 2

C. Level 3 (12 credits)

- ☐ **SCED 5500** Student Teaching Seminar (2 weeks) (F,Sp) 2
- ☐ **SCED 5630** Student Teaching in Secondary Schools (13 weeks, full-time) (F,Sp) 10

[5]The Science methods courses (SCED 3400 and 4400) may *only* be taught *once per year*. Therefore, students should take whichever one is taught during the term they are in Level 1 or Level 2.

[6]Prior to Summer Semester 2006, this course was taught under a different number. The number was changed due to House Bill 320 (Common Course Numbering). The prior course number is shown in parentheses, following *formerly*.

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 their departments concerning possible changes.

Materials for Persons with Disabilities

This requirement sheet is available in large print, audio, and braille format upon request to the USU Disability Resource Center.

For information contact

Physics Department; Science Engineering Research 250; Utah State University; 4415 Old Main Hill; Logan UT 84322-4415; tel. (435) 797-2857; e-mail physics@cc.usu.edu; **http://www.physics.usu.edu**

Prepared by Registrar's Office, Utah State University