## Physics—Biological Emphasis

### Freshman Year

#### Fall Semester
- **Math 1371 Calculus I**
  - (placement into course, or pre-req)
- **Phys 1301W Intro Physics I**
  - (Math 1371)
- **Biol 1009 General Biology**
- **CSE 1001 1st Yr Experience**
- **Liberal Education course or Writ 1301**

#### Spring Semester
- **Math 1372 Calculus II**
- **Phys 1302W Intro Physics II**
- **Chem 1065 Chem Princ I Lab**
- **Liberal Education course or Writ 1301**

### Sophomore Year

#### Fall Semester
- **Math 2373 Lin Alg/Diff Eq**
- **Phys 2303 Phys III: Waves, Optics**
- **Chem 1061 Chem Princ I**
- **Liberal Education course or Writ 1301**
- **Liberal Education course or Writ 1301**

#### Spring Semester
- **Math 2374 Multivariable Calc**
- **Phys 2304 Math for Physics**
- **Chem 1062 Chem Princ II Lab**
- **Liberal Education course or Writ 1301**

### Junior Year

#### Fall Semester
- **Phys 4001 Analytical Mech**
  - (2503 or 2601, 3041, Math 2374)
- **Phys 4051 Experimental Phys I**
  - (1062/66)
- **Chem 2301 Organic Chem I**
- **Liberal Education course**

#### Spring Semester
- **Phys 4002 Elect & Magnetism**
  - (2503 or 2601, 3041, Math 2374)
- **Phys 4052W Experimental Phys II**
- **BioC 3021 Biochemistry**
- **Liberal Education course**

### Senior Year

#### Fall Semester
- **Phys 4101 Quantum Mech**
  - (2503 or 2601, 3041, Math 2374)
- **Phys 4201 Stat Therm Phys**
- **Liberal Education course**
- **Open Elective**

#### Spring Semester
- **Technical Elective I**
- **Technical Elective II**
- **Open Elective**
- **Open Elective**

### About This Plan
- This plan is not a contract. Curriculum can change. The APAS is the official method for tracking completion of University degree requirements.
- Shaded courses are only offered in the indicated semester.
- Course pre-requisites and co-requisites (designated by &) are listed below the course number and title.
- Students may take either the CSE-only or University-wide versions of math courses (Math 1371/1271, 1372/1272, 2373/2243, 2374/2263).
- Students applying to the major prior to Fall 2018 are eligible based on completion of either Math 2373 or Math 2374 (or equivalent).

### Applying to your Major
Students who have completed the required courses for admission to this major (indicated with double boxes on plan) and have a 3.2 UM-TC technical GPA at the end of the fall semester will be guaranteed admission. All other students who have completed the required courses will be considered for admission on a space-available basis. Admission following the spring semester is only based on space availability. The major application database is available at z.umn.edu/csemajorapp.

### Total Credits Needed for Degree: 120
What can I do with a major in...

Physics

**ACTIVITIES PHYSICS MAJORS DO:**

Physicists explore and identify the basic principles governing the structure and behavior of matter, the generation and transfer of energy, and the interaction of matter and energy. Some physicists use these principles in theoretical areas such as the nature of time and the origin of the universe. Others work in more practical areas such as the development of materials, electronic or optical devices, and medical equipment. Physicists design and perform experiments with lasers, cyclotrons, telescopes, mass spectrometers, and other equipment. For instance, lasers are used in surgery, microwave devices function in ovens, and measuring instruments can analyze blood or the chemical content of foods. Physicists also find ways to apply mathematics and physical laws and theories to problems in nuclear energy, electronics, optics, materials, communications, aerospace technology, navigation equipment, and medical instrumentation. Many physicists work in research and development. Some do basic research to increase scientific knowledge or applied research to build on basic knowledge. For example, knowledge gained through basic research in solid-state physics led to the development of transistors and then integrated circuits used in computers. A small number of physicists work in inspection, testing, quality control, and other production-related jobs in industry.

Physicists generally specialize in one of the following areas: acoustics, astronomy, astrophysics, atmospheric physics, biophysics, chemical physics, cryogenics, electromagnetism, energy, environmental physics, fluid mechanics, geophysics, medical physics, metallurgy, nuclear physics, optical physics, plasma physics, theology, solid state physics, or vacuum physics. Research in physics often requires a Ph.D.

**INDUSTRIES PHYSICS MAJORS WORK IN (SAMPLE LISTING):**

<table>
<thead>
<tr>
<th>Petroleum/mining</th>
<th>Telecommunications</th>
<th>Government agencies</th>
<th>Consulting</th>
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<tbody>
<tr>
<td>Engineering consulting</td>
<td>Research and development</td>
<td>Observatories</td>
<td>Automotive</td>
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<tr>
<td>Optics/electronics</td>
<td>Nuclear plants</td>
<td>Information technology</td>
<td>Materials supply</td>
</tr>
<tr>
<td>Educational institutions</td>
<td>Biomedical</td>
<td>Aerospace/aeronautical</td>
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**EMPLOYERS WHO HIRE PHYSICS MAJORS (SAMPLE LISTING):**

- 3M
- Bose Corporation
- Graco Inc.
- NASA
- IBM
- Polar Semiconductor, LLC
- Alliant Techsystems
- Epic
- Intel Corporation
- Black River Systems Co.
- Microsoft Corporation
- LasX Industries Inc.
- Applied Materials
- ExxonMobil
- General Electric
- Seagate Technology
- Schlumberger
- John Hopkins Applied Phys. Lab
- D.E. Shaw Research
- Starkey Hearing Technologies
- NAVAIR Weapons Division
- MIT Lincoln Laboratory
- Garmin International

**TYPES OF POSITIONS FOR PHYSICS MAJORS (SAMPLE LISTING):**

- **Physical scientist:** Conducts research, testing, evaluation, and analysis related to the identification and evaluation of products and features such as counterfeit deterrent security features for Federal Reserve Notes. Specifically, physical scientists advise on and administer scientific work in the investigation and application of optical/light principles.

- **Field test engineer:** Performs electro-optical (EO) or infrared (IR) measurements, both on site and at field test sites as part of a small team. Field test engineers develop/upgrade instrumentation and software for control and analysis, document test procedures and experimental setups, and analyze and document the results of the tests and measurements.

- **Thin film deposition engineer:** Conducts product development on thin film deposition using vacuum systems. Duties include operation and maintenance of a vacuum system; designing and constructing part of the system as needed; analysis of the deposited thin film; and designing of experiments, analyzing results, and reporting.

- **Rheologists:** Applies physics to the study of the deformation and flow of matter. For instance, rheologists apply the principles behind the observation in the differences in the flow of ketchup from a bottle before and after shaking the bottle.

**Some of these positions may require an advanced degree.**