# Physics - Biological Emphasis

## Freshman Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 1371 Calculus I (placement into course, or pre-req)</td>
<td>Math 1372 Calculus II (1371)</td>
</tr>
<tr>
<td>Phys 1301W Intro Physics I (Math 1371)</td>
<td>Phys 1302W Intro Physics II (1301, &amp;Math 1372)</td>
</tr>
<tr>
<td>Biol 1009 General Biology</td>
<td>CSCI 1113 Intro to C/C++ (1371)</td>
</tr>
<tr>
<td>Liberal Education course</td>
<td>Liberal Education course</td>
</tr>
</tbody>
</table>

| Liberal Education course                          | CSE 1001: 1st Yr Experience                         |

## Sophomore Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 2373 Lin Alg/Diff Eq. (1372)</td>
<td>Math 2374 Multivar. Calculus (1372)</td>
</tr>
<tr>
<td>Phys 2201 Thermo &amp; Stat Physics (1802, Math 1372)</td>
<td>Phys 2601 Quantum Physics (2503, &amp;2605, &amp;Math 2373)</td>
</tr>
<tr>
<td>Chem 1061/65 Chem Princ I (placement into course, or 1015)</td>
<td>Chem 1062/66 Chem Princ II (1061/65)</td>
</tr>
</tbody>
</table>

## Junior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 4001 Analytical Mech (2503 or 2601, Math 2373, Math 2374)</td>
<td>Phys 4002 Elect &amp; Magnetism (2503 or 2601)</td>
</tr>
<tr>
<td>Phys 4051 Experimental Phys I (2605 or equiv lab exp or Inst Consent)</td>
<td>Phys 4052W Experimental Phys II (4051)</td>
</tr>
<tr>
<td>Liberal Education Course</td>
<td>Liberal Education Course</td>
</tr>
</tbody>
</table>

## Senior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 4101 Quantum Mech (2503 or 2601 or Chem 4501 or 4502)</td>
<td>Technical Elective</td>
</tr>
<tr>
<td>Phys 4201 Stat Therm Phys (2601)</td>
<td>Technical Elective</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>Liberal Education Course</td>
</tr>
<tr>
<td>Liberal Education Course</td>
<td>Open Elective (If needed to reach 120 credits)</td>
</tr>
</tbody>
</table>

## About This Plan

- This plan is not a contract. Curriculum can change.
- 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).
- Double boxed courses, along with one of two courses with a dashed outline, are required for application to this major.
- Liberal Education and Writing requirements with an (*) will be fulfilled by taking courses required for this major at UM-TC.

## Applying to your Major

Students who have completed the required courses for admission to this major 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.

## Department Contact Information

- Website: www.physics.umn.edu/undergrad/
- Main Phone: 612-624-7375
- Main Office: Williamson Hall
- Director of Undergraduate Studies: Jeremy Mans
- Department Advisor: advisor@physics.umn.edu
- Department E-mail: info@physics.umn.edu

## University Degree Requirements

All students must complete the following Writing & Liberal Education requirements, as noted on their APAS report. See link for full Core & Theme names: z.umn.edu/liberaleducation

### Writing Requirements

**Freshman Writing:**
Writ 1301/1401 or equivalent

**Writing Intensive (WI):**
Two: 1xxx or 2xxx level **
One: 3/4/5xxx level (in major)*
One: 3/4/5xxx level (any dept.)

### Liberal Education

<table>
<thead>
<tr>
<th>CORES</th>
<th>THEMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio</td>
<td>Civ</td>
</tr>
<tr>
<td>Phy*</td>
<td>DJ</td>
</tr>
<tr>
<td>His</td>
<td>Env</td>
</tr>
<tr>
<td>SocS</td>
<td>GP</td>
</tr>
<tr>
<td>Litr</td>
<td>TS</td>
</tr>
<tr>
<td>AH</td>
<td></td>
</tr>
<tr>
<td>Mth*</td>
<td></td>
</tr>
</tbody>
</table>

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

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 in 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, rheology, solid state physics, or vacuum physics. Research in physics often requires a Ph.D.

Employers (sample listing)

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

Industries (sample listing)

- Petroleum/mining
- Telecommunications
- Government agencies
- Engineering consulting
- Research and development
- Observatories
- Optics/electronics
- Nuclear plants
- Information technology
- Educational institutions
- Biomedical
- Materials supply
- Automotive
- Aerospace/aeronautical
- Consulting

Positions (sample listing)

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

Field Test Engineer: Performs electro-optical or infrared measurements, both on-site and at field test sites as part of a team. Field test engineers develops instrumentation and software for control and analysis, documents test procedures and experimental setups, and analyzes and documents 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 thin film; designing of experiments; and analyzing results and reporting.

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

*Some positions may require an advanced degree.

Career Center
cse.umn.edu/career
Salary Information
z.umn.edu/csesalary
More Information on Undergraduate Majors
cse.umn.edu/majors