Human Physiology

John Halliwill, Department Head
541-346-4107
541-346-2841 fax
181 Esslinger Hall

Human physiology is the science of the mechanical, physical, and biochemical function of humans, and serves as the foundation of modern medicine. As a discipline, it connects science, medicine, and health, and creates a framework for understanding how the human body adapts to stresses, physical activity, and disease.

Human physiology and anatomy are closely related—anatomy is the study of form, physiology is the study of function, and form and function are intrinsically linked. The study of human physiology integrates knowledge across many levels, including biochemistry, cell physiology, and organ systems. Contemporary research in human physiology explores new ways to maintain or improve the quality of life, the development of new medical therapies and interventions, and the unanswered questions about how the human body works. The Department of Human Physiology serves its students by providing strong training in human physiology and anatomy to prepare them for careers in medicine, allied health professions, and biomedical research.

Faculty
Damien Callahan, assistant professor. BA, 2001, Boston; PhD, 2011, Massachusetts, Amherst. (2017)


Robin Hopkins, senior instructor. BS, 2005, Simon Fraser; MS, 2009, Western Ontario; PhD, 2014, British Columbia. (2014)


Michelle Marneweck, assistant professor. BA, 2020, MS/PhD, 2014, Western Australia. (2020)


Elinor Sullivan, research associate professor, Evergreen Professor. BA, 2000, Willamette; PhD, 2006, Oregon Health and Science. (2017)

Nicole Swann, assistant professor. BA, 2006, California, Berkeley; PhD, 2012, California, San Diego. (2017)


Affiliated

Balamurali Ambati, MD, PhD. Courtesy research professor, Phil and Penny Knight Campus for Accelerating Scientific Impact.

Sierra Dawson, PhD. Associate Vice Provost for Academic Affairs.

Jon Elliot, PhD. Instructor pro tem. (2019)


Marian Hettiaratchi, PhD. Assistant Professor, Phil and Penny Knight Campus for Accelerating Scientific Impact.

Austin Hocker, PhD. Assistant Director for Research and Assessment, Teaching Engagement Program.


Benjamin McKay, MS. Sports Science Coordinator, Intercollegiate Athletics.


Keat Ghee Ong, PhD. Professor, Phil and Penny Knight Campus for Accelerating Scientific Impact.


Ann Zeidman-Karpinski, associate professor. See Libraries.

Courtes


The anatomy and physiology sequence (HPHY 321–325) provides the bulk of upper-division credits human physiology majors complete. The courses are the foundation on which students learn the human physiology culture and expectations, and are designed to prepare students for senior-level course work in the major. As a result, HPHY 321–325 must be completed in residence at the University of Oregon; transfer students should plan on taking the courses on the UO campus.
Scholarships
Numerous scholarships are available; a complete list is available on the department website.

Careers
A degree in human physiology prepares students to be critical thinkers who can independently assess their own personal health, using the guiding principles of scientific inquiry as a model for understanding the world around them. Students seeking a career in medicine, dentistry, physical therapy, or other health professions should work closely with the human physiology undergraduate advisor as well as health professions advisors to plan their program of study to meet the specific admission requirements of the postgraduate schools in which they are interested. Information on additional courses that may be required for graduate programs is available from the Health Professions Program (http://healthprofessions.uoregon.edu/health-fields/) website.

Bachelor of Arts Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower-Division Requirements</td>
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</tr>
<tr>
<td>CH 221</td>
<td>General Chemistry I</td>
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<tr>
<td>&amp; CH 222</td>
<td>and General Chemistry II</td>
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<td>&amp; CH 223</td>
<td>and General Chemistry III</td>
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<tr>
<td>or CH 224H</td>
<td>Advanced General Chemistry I</td>
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<td>&amp; CH 225H</td>
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<td>&amp; CH 226H</td>
<td>and Advanced General Chemistry III</td>
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<td>CH 227</td>
<td>General Chemistry Laboratory</td>
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<tr>
<td>&amp; CH 228</td>
<td>and General Chemistry Laboratory</td>
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<tr>
<td>&amp; CH 229</td>
<td>and General Chemistry Laboratory</td>
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<tr>
<td>or PHYS 204</td>
<td>Introductory Physics Laboratory</td>
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<tr>
<td>&amp; PHYS 205</td>
<td>and Introductory Physics Laboratory</td>
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<tr>
<td>&amp; PHYS 206</td>
<td>and Introductory Physics Laboratory</td>
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<tr>
<td>BI 211</td>
<td>General Biology I: Cells</td>
<td>12-15</td>
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<tr>
<td>&amp; BI 212</td>
<td>and General Biology II: Organisms</td>
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<tr>
<td>&amp; BI 213</td>
<td>and General Biology III: Populations (may substitute BI 214 for BI 213)</td>
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<tr>
<td>or BI 281H</td>
<td>Honors Biology I: Cells, Biochemistry and Physiology</td>
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<tr>
<td>&amp; BI 282H</td>
<td>and Honors Biology II: Genetics and Molecular Biology</td>
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<tr>
<td>&amp; BI 283H</td>
<td>and Honors Biology III: Evolution, Diversity and Ecology</td>
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<td>MATH 246</td>
<td>Calculus for the Biological Sciences I</td>
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<td>or MATH 251</td>
<td>Calculus I</td>
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<tr>
<td>PHYS 201</td>
<td>General Physics</td>
<td>12</td>
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<tr>
<td>&amp; PHYS 202</td>
<td>and General Physics</td>
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<tr>
<td>&amp; PHYS 203</td>
<td>and General Physics</td>
<td></td>
</tr>
<tr>
<td>or PHYS 251</td>
<td>Foundations of Physics I</td>
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<tr>
<td>&amp; PHYS 252</td>
<td>and Foundations of Physics I</td>
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<tr>
<td>&amp; PHYS 253</td>
<td>and Foundations of Physics I</td>
<td></td>
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<tr>
<td>HPHY 211</td>
<td>Medical Terminology</td>
<td>3</td>
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<tr>
<td>HPHY 212</td>
<td>Scientific Investigation in Physiology</td>
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<tr>
<td>Upper-Division Requirements</td>
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<td>HPHY 321</td>
<td>Human Anatomy I</td>
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<tr>
<td>HPHY 322</td>
<td>Human Physiology I</td>
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<tr>
<td>HPHY 323</td>
<td>Human Anatomy II</td>
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<td>HPHY 324</td>
<td>Human Physiology II</td>
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<tr>
<td>HPHY 325</td>
<td>Human Anatomy and Physiology III</td>
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<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>HPHY 371</td>
<td>Physiology of Exercise</td>
<td>4</td>
</tr>
</tbody>
</table>

Select at least two of the following:

- HPHY 333 Motor Control
- HPHY 362 Tissue Injury and Repair
- HPHY 374 Clinical Electrocardiography and Exercise
- HPHY 375 Metabolism and Nutrition
- HPHY 381 Biomechanics
- HPHY 399 Special Studies: [Topic]
- ANTH 362 Human Biological Variation
- ANTH 366 Human Osteology Laboratory
- ANTH 369 Human Growth and Development
- BI 309 Tropical Diseases in Africa
- BI 320 Molecular Genetics
- BI 322 Cell Biology
- BI 358 Investigations in Medical Physiology
- BI 360 Neurobiology
- CH 360 Physiological Biochemistry
- CH 462 Biochemistry

Select at least one of the following capstone courses:

- HPHY 412 Sleep Physiology
- HPHY 413 Muscle Structure, Function, and Plasticity
- HPHY 414 Muscle Metabolism
- HPHY 422 Physiology of Obesity
- HPHY 423 Physiology of Aging
- HPHY 432 Neural Development
- HPHY 433 Neurophysiology of Concussion
- HPHY 434 Movement Disorders
- HPHY 436 Clinical Neuroscience
- HPHY 444 Clinical Anatomy
- HPHY 462 Therapeutic Techniques
- HPHY 470 Environmental Physiology
- HPHY 472 Science of Athletic Performance
- HPHY 473 High Altitude Physiology and Medicine

Select any of the following:

- HPHY 401 Research: [Topic]
- HPHY 403 Thesis
- HPHY 404 Internship: [Topic]
- HPHY 405 Reading and Conference: [Topic]
- HPHY 406 Special Problems: [Topic]
- HPHY 408 Workshop: [Topic]
- HPHY 409 Practicum: [Topic] (Anatomy and Physiology Teaching Assistant)
- HPHY 411 Scientific Teaching
- HPHY 420 Human Anatomy Dissection

1. Should be taken in the first year.
2. Must be taken in residence at the University of Oregon.
Bachelor of Science Degree Requirements

**Lower-Division Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CH 221–223</td>
<td>General Chemistry ¹</td>
<td>12</td>
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<tr>
<td>or CH 224H–226H</td>
<td>Honors General Chemistry</td>
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<tr>
<td>PHYS 201–203</td>
<td>General Physics</td>
<td>12</td>
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<tr>
<td>or PHYS 251–253</td>
<td>Foundations of Physics I</td>
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<td>CH 227–229</td>
<td>General Chemistry Laboratory</td>
<td>6</td>
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<td>or PHYS 204–206</td>
<td>Introductory Physics Laboratory</td>
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<tr>
<td>BI 211–213</td>
<td>General Biology I-III (may substitute BI 214 for BI 213)</td>
<td>12-15</td>
</tr>
<tr>
<td>or BI 281H–283H</td>
<td>Honors Biology I-III</td>
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</tr>
<tr>
<td>MATH 246</td>
<td>Calculus for the Biological Sciences I ¹</td>
<td>4</td>
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<tr>
<td>or MATH 251</td>
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</tr>
<tr>
<td>HPHY 211</td>
<td>Medical Terminology</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 212</td>
<td>Scientific Investigation in Physiology</td>
<td>4</td>
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**Upper-Division Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>HPHY 321</td>
<td>Human Anatomy I ²</td>
<td>5</td>
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<tr>
<td>HPHY 322</td>
<td>Human Physiology I ²</td>
<td>5</td>
</tr>
<tr>
<td>HPHY 323</td>
<td>Human Anatomy II ²</td>
<td>5</td>
</tr>
<tr>
<td>HPHY 324</td>
<td>Human Physiology II ²</td>
<td>5</td>
</tr>
<tr>
<td>HPHY 325</td>
<td>Human Anatomy and Physiology III ²</td>
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<tr>
<td>HPHY 371</td>
<td>Physiology of Exercise</td>
<td>4</td>
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</tbody>
</table>

**Upper-Division Electives**

16 credits

Select at least two of the following:

- HPHY 332 Motor Control
- HPHY 362 Tissue Injury and Repair
- HPHY 374 Clinical Electrocardiography and Exercise
- HPHY 375 Metabolism and Nutrition
- HPHY 381 Biomechanics
- HPHY 399 Special Studies: [Topic]
- ANTH 362 Human Biological Variation
- ANTH 366 Human Osteology Laboratory
- ANTH 369 Human Growth and Development
- BI 309 Tropical Diseases in Africa
- BI 320 Molecular Genetics
- BI 322 Cell Biology
- BI 358 Investigations in Medical Physiology
- BI 360 Neurobiology
- CH 360 Physiological Biochemistry
- CH 462 Biochemistry

Select at least one of the following capstone courses:

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- HPHY 414 Muscle Metabolism
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- HPHY 423 Physiology of Aging
- HPHY 433 Neuropysiology of Concussion
- HPHY 432 Neural Development
- HPHY 434 Movement Disorders
- HPHY 436 Clinical Neuroscience
- HPHY 444 Clinical Anatomy
- HPHY 462 Therapeutic Techniques
- HPHY 470 Environmental Physiology
- HPHY 472 Science of Athletic Performance
- HPHY 473 High Altitude Physiology and Medicine

Select any of the following:

- HPHY 401 Research: [Topic]
- HPHY 403 Thesis
- HPHY 404 Internship: [Topic]
- HPHY 405 Reading and Conference: [Topic]
- HPHY 406 Special Problems: [Topic]
- HPHY 408 Workshop: [Topic]
- HPHY 409 Practicum: [Topic]
- HPHY 409 Practicum: [Topic] (Anatomy and Physiology Teaching Assistant)
- HPHY 411 Scientific Teaching
- HPHY 420 Human Anatomy Dissection

¹ Should be taken in the first year.
² Must be taken in residence at the University of Oregon.

Courses required for the major must be taken for letter grades and passed with grades of mid-C or better. Required preparatory and upper-division core courses may be repeated only once, including attempts that result in a grade of ‘W’ (withdrawal). Students must maintain at least an overall 2.00 grade point average in courses required for the major.

Additional requirements for the bachelor's degree are described in the Bachelor's Degree Requirements section of this catalog.

**Honors**

To apply to graduate with departmental honors, a student must have a GPA of 3.50 or better in courses applied toward the human physiology degree requirements and complete an honors thesis under the supervision of a human physiology thesis committee. In addition, human physiology majors enrolled in the Robert Donald Clark Honors College at the University of Oregon are eligible to complete an honors thesis through that program.

**Four-Year Degree Plan**

The degree plan shown is only a sample of how students may complete their degrees in four years. There are alternative ways. Students should consult their advisor to determine the best path for them.

The bachelor of science is shown below. A bachelor of arts in human physiology may be earned by completing (or demonstrating proficiency in) two years of a foreign language.

**Bachelor of Science in Human Physiology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 112</td>
<td>Elementary Functions ¹</td>
<td>4</td>
</tr>
<tr>
<td>CH 221</td>
<td>General Chemistry I</td>
<td>4</td>
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</tbody>
</table>

¹ Should be taken in the first year.

The bachelor of science is shown below. A bachelor of arts in human physiology may be earned by completing (or demonstrating proficiency in) two years of a foreign language.
### Second Year

#### Fall
- **BI 211**  General Biology I: Cells  
- **HPHY 211**  Medical Terminology  
- **General-education course**  
  - 4 credits
- **Elective course**  
  - 4 credits
- **Credits**  
  - 15 credits
- **Milestones**

#### Winter
- **CH 227**  General Chemistry Laboratory  
  - Students may choose to complete either a year of chemistry lab or physics lab.
- **General-education course**  
  - 4 credits
- **Elective course**  
  - 4 credits
- **Credits**  
  - 15 credits

### Third Year

#### Fall
- **HPHY 321**  Human Anatomy I  
- **HPHY 322**  Human Physiology I  
- **Upper-division elective courses**  
  - 3 credits
- **Credits**  
  - 13 credits
- **Milestones**

#### Winter
- **HPHY 323**  Human Anatomy II  
- **HPHY 324**  Human Physiology II  
- **Upper-division elective courses**  
  - 3 credits
- **Credits**  
  - 13 credits
- **Milestones**

#### Spring
- **HPHY 325**  Human Anatomy and Physiology III  
- **HPHY 371**  Physiology of Exercise  
  - HPHY 321–325 as well as HPHY 371 should be complete by the end of the third year.
- **General-education course**  
  - 4 credits
- **Upper-division elective course**  
  - 2 credits
- **Credits**  
  - 15 credits
- **Milestones**

#### Credits

- **Total Credits**  
  - 41 credits
### Human Physiology Course Title

**Fourth Year**

**Fall**

- **PHYS 201** General Physics

  Students who did not opt to complete the chemistry lab will need to complete a year of physics lab.

  - Human physiology course chosen from List A
  - General-education course
  - Upper-division elective course

  Total Credits: 15

**Winter**

- **PHYS 202** General Physics

  - Human physiology course chosen from List A
  - Upper-division elective course

  Total Credits: 15

**Spring**

- **PHYS 203** General Physics

  - Human physiology course chosen from List A or List B
  - General-education course
  - Upper-division elective course

  Total Credits: 15

**Total Credits**: 45

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1. Students not starting in Elementary Functions (MATH 112) may require additional terms to graduate.
2. To complete general-education requirements within eight courses, students must take arts and letters or social science group-satisfying courses that also satisfy multicultural requirements.
3. List A and List B options may be found online (https://physiology.uoregon.edu/wp-content/uploads/sites/5/2013/03/HPHY-Major-Requirements.pdf).

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### Master of Science Degree Requirements: Athletic Training

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>HPHY 520</td>
<td>Human Anatomy Dissection</td>
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<tr>
<td>HPHY 533</td>
<td>Neurophysiology of Concussion</td>
<td>4</td>
</tr>
<tr>
<td>HPHY 570</td>
<td>Environmental Physiology</td>
<td>4</td>
</tr>
<tr>
<td>HPHY 611</td>
<td>Professional Skills I: Effective Teaching</td>
<td>1</td>
</tr>
<tr>
<td>HPHY 660</td>
<td>Basic Science in Clinical Decisions</td>
<td>4</td>
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<tr>
<td>HPHY 661</td>
<td>Manual Therapy: Movement Patterns, Core Stability</td>
<td>2</td>
</tr>
<tr>
<td>HPHY 662</td>
<td>Manual Therapy: Spine, Lower Quadrant</td>
<td>2</td>
</tr>
<tr>
<td>HPHY 669</td>
<td>The Female Athlete</td>
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<tr>
<td>HPHY 671</td>
<td>Therapeutic Restoration of Biomotor Abilities</td>
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<tr>
<td>EDUC 614</td>
<td>Educational Statistics</td>
<td>4</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Administrative Skills for Clinical Careers)</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Clinical Research Presentations [two terms])</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Contemporary Clinical Techniques I,II)</td>
<td>2</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Current Professional Topics)</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Evidence-Based Clinical Practice and Research)</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Human Physiology [six terms])</td>
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<tr>
<td>HPHY 607</td>
<td>Seminar: [Topic] (Leadership Development)</td>
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<tr>
<td>HPHY 609</td>
<td>Practicum: [Topic] (Sports Medicine)</td>
<td>3</td>
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</tbody>
</table>

Select one of the following:

- HPHY 601 Research: [Topic]
- HPHY 606 Special Problems: [Topic]
- HPHY 609 Practicum: [Topic] (Preceptor)

Other human physiology courses

Total Credits: 52

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### Graduate Studies

The Department of Human Physiology offers two graduate programs: the athletic training MS program and the research-intensive MS-PhD program.

### Athletic Training MS Program

The department offers a graduate program in human physiology with an emphasis in athletic training leading to the master of science (MS). The primary goal of this program is to provide classroom and clinical experiences that will allow entry-level certified athletic trainers to grow into professionals with the experience and confidence to be great clinicians. Providing students with advanced clinical skills is our hallmark. The program also provides students with the opportunity to grow as leaders, teachers, and researchers. Admission is granted only to students who are certified by the CAATE Board of Certification or who have qualified for the certification examination. Graduate employee (GE) positions are available for highly qualified students who are certified as athletic trainers. The GE award provides a full tuition waiver and a monthly stipend that varies in amount according to the assignment. Employment settings include intercollegiate athletics, club and recreational sports, and teaching. Qualified students can find more information at the Graduate Studies in Athletic Training website (http://pages.uoregon.edu/uogradat/).

### Master of Science–Doctor of Philosophy: Research-Intensive Emphasis

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### Exit Requirement

All students participate in a comprehensive defense of their advanced clinical skills during spring term of their graduating year. In addition,
they select one of the following two options as their graduation exit requirement:

- **Option 1.** Comprehensive written and oral exams (completed during the final term of study), one-term (4-credit minimum) research experience, and literature review or evidence-based practice manuscript submitted for publication.
- **Option 2.** Original research study conducted, and manuscript submitted for publication.

**Additional Requirements**

Required courses must be taken for letter grades and passed with grades of B– or better. Students must maintain at least a 3.00 grade point average each term, and will not be eligible to hold a graduate employee (GE) position, take comprehensive exams, or graduate without a cumulative GPA of 3.00. Additional university master’s degree requirements are described under Master’s Degrees in the Graduate School section of this catalog.

**Research-Intensive Master of Science–Doctor of Philosophy Program**

The department offers a graduate program in human physiology with an emphasis on research leading through the master of science (MS) degree to the doctor of philosophy (PhD) degree. The goal is to provide classroom and research experiences that turn students into professionals with the knowledge and experience to be superior researchers or become university-level educators. This is an individualized program with a strong emphasis on research. Decisions on accepting applicants to the graduate program are made by the faculty members, and are based on available laboratory space and financial support—both of which vary greatly from year to year. Graduate employee (GE) opportunities and research fellowships are available for highly qualified students to teach undergraduate laboratories or assist in research projects. The GE award provides a full-tuition waiver and a monthly stipend that varies in amount according to the assignment. For more information, visit the department website.

**Master of Science Degree Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPHY 611</td>
<td>Professional Skills I: Effective Teaching &amp; Professional Skills II: Responsible</td>
<td>3</td>
</tr>
<tr>
<td>&amp; HPHY 612</td>
<td>Research &amp; Professional Skills III: Career Development</td>
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<tr>
<td>&amp; HPHY 613</td>
<td>Systems Physiology I</td>
<td>12</td>
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<tr>
<td>&amp; HPHY 622</td>
<td>and Systems Physiology II</td>
<td></td>
</tr>
<tr>
<td>&amp; HPHY 623</td>
<td>and Systems Physiology III</td>
<td></td>
</tr>
<tr>
<td>EDUC 614</td>
<td>Educational Statistics</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 640</td>
<td>Applied Statistical Design and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Human physiology courses or other courses most appropriate to student’s line of study</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total Credits</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

1 Statistical analysis courses covering the following topics: descriptive statistics, logic of hypothesis testing, elementary inferential statistics, confidence intervals, one-way analysis of variance, post hoc comparisons, a priori contrasts, within-subjects and between-subjects effects, two-way and higher-order designs, and interactions. For recent additions to these course options, check with the director of graduate studies for the department.

2 Determined in conjunction with program committee.

3 Must register for course every term of enrollment after advancing to candidacy.

The doctoral degree requires completion of a minimum of 135 credits beyond the bachelor’s degree; at least 60 of these credits must be completed through human physiology courses. Written and oral doctoral comprehensive examinations are taken after completing a substantial
portion of the program of study. Upon passing these examinations, the student is advanced to candidacy. A final oral defense is held after completion of the dissertation and after all other degree requirements have been met. Required courses must be taken for letter grades and passed with grades of B– or better. Students must maintain at least a 3.00 grade point average for all courses. Additional university doctor of philosophy degree requirements are described under Doctoral Degrees in the Graduate School section of this catalog.

Admission Requirements

Applicants for the athletic training MS program should check the Graduate Studies in Athletic Training website (http://pages.uoregon.edu/ugradat/) and applicants for the research-intensive MS-PhD program should check the department website (http://physiology.uoregon.edu) for information on the online graduate application and deadlines.

Recommended criteria for applying to all graduate programs include the following:

- Baccalaureate degree from an accredited university with a GPA of 3.40 or higher on a 4.00 scale
- Completed course work with a grade of B+ or better in general chemistry, general biology, and two courses of physiology or combined anatomy and physiology.
- International students who have not received a degree from a university in a country whose official language is English must have a TOEFL score of 575 (paper test) or 90 (Internet-based test) or an IELTS overall band score of 7.0.

Minimum requirements for admission to all graduate programs include the following:

- Baccalaureate degree from an accredited university with a GPA of 3.00 or higher on a 4.00 scale
- Completed course work with a grade of B– or better in general chemistry, general biology, and two courses of physiology or combined anatomy and physiology.
- International students who have not received a degree from a university in a country whose official language is English must have a TOEFL score of 575 (paper test) or 90 (Internet-based test) or an IELTS overall band score of 7.0.

In addition, for graduate studies in athletic training:

- Recommended GRE scores of 153 or better on each of the verbal and quantitative sections (institution code: 4846; department code: 0217); minimum GRE scores of 148 or better on each of the verbal and quantitative sections
- Completed course work with a grade of B– or better in physics and biomechanics
- Must be a certified athletics trainer at time of matriculation

Courses

**PHFY 103. Exercise and Performance. 4 Credits.**
Structure and function of the human body including movement analysis. Topics include training and exercise responses; sport, daily living, and workplace performance; and injury adaptations.

**PHFY 105. Principles of Nutrition. 4 Credits.**
Explores the fundamentals of nutrition and its application to culture, lifestyle, and health as they relate to humans across the lifespan. Course will be taught once or more per academic year.

**PHFY 111. The Science of Sex. 4 Credits.**
The anatomy and physiology of sex, with assignments and discussion designed to develop scientific literacy.

**PHFY 112. The Science of Health. 4 Credits.**
Examines and assesses current health claims and controversies.

**PHFY 199. Special Studies: [Topic]. 1-4 Credits.**
Repeatable.

**PHFY 211. Medical Terminology. 3 Credits.**
Explore and develop skills in language and terminology specific to the medical sciences with an emphasis on derivation, meaning, and pronunciation.

**PHFY 212. Scientific Investigation in Physiology. 4 Credits.**
Explores the process of conducting and communicating scientific research, and how data and statistics help us build and understand scientific knowledge about physiology and medicine.

**PHFY 321. Human Anatomy I. 5 Credits.**
Introduction to the human body and histology; nerves; central, autonomic, and peripheral nervous systems; cranial nerves; regional anatomy of the head; special senses. Includes cadaver laboratory. Sequence with HPHY 322, 323, 324, 325.
Prereq: HPHY 211; BI 211 or BI 281H; BI 212 or BI 282H; CH 221 or CH 224H; CH 222 or CH 225H; CH 223 or CH 226H; MATH 246 or MATH 251. Must be passed with grades of C or better.

**PHFY 322. Human Physiology I. 5 Credits.**
Neuro- and muscular physiology: action potentials; synapses and receptors; skeletal muscle; central, peripheral, and autonomic nervous systems; special senses. Includes human-based laboratory. Sequence with HPHY 321, 323, 324, 325.
Prereq: HPHY 211; BI 211 or BI 281H; BI 212 or BI 282H; CH 221 or CH 224H; CH 222 or CH 225H; CH 223 or CH 226H; MATH 246 or MATH 251. Must be passed with grades of C or better.

**PHFY 323. Human Anatomy II. 5 Credits.**
Heart, lungs, and vasculature in addition to regional exploration of the musculoskeletal system. Includes cadaver laboratory. Sequence with HPHY 321, 322, 324, 325.
Prereq: HPHY 321. Must be passed with grades of C or better.

**PHFY 324. Human Physiology II. 5 Credits.**
Cardiovascular system; respiratory system; immunology. Includes human-based laboratory. Sequence with HPHY 321, 322, 323, 325.
Prereq: HPHY 212, HPHY 321, HPHY 322. Must be passed with grades of C or better.

**PHFY 325. Human Anatomy and Physiology III. 5 Credits.**
Anatomy and physiology of the digestive, reproductive, and renal systems; endocrinology. Includes combination of cadaver laboratory and human-based laboratory. Sequence with HPHY 321, 322, 323, 324.
Prereq: HPHY 323, HPHY 324. Must be passed with a grade of C or better.

**PHFY 333. Motor Control. 4 Credits.**
Introduction to the processes of control and coordination in the performance of motor skills. Neuropsychological, mechanical, and cognitive bases of motor skill acquisition.
Prereq: HPHY 321, HPHY 322; or PSY 304. Must be passed with grades of C or better.
PHY 337. Clinical Pharmacology. 4 Credits.
Examines the pharmacokinetics (absorption, distribution, metabolism, excretion), pharmacodynamics, therapeutic considerations and adverse effects of select prototypes from within major clinically relevant drug families.
Prereq: PHY 325. Must be passed with grades of C or better.

PHY 362. Tissue Injury and Repair. 4 Credits.
Exploration of the physiology of injury and trauma. Emphasis on inflammation and healing of connective tissue injury, tissue biomechanics, mechanisms of injury, and clinical orthopedic evaluation techniques.
Prereq: PHY 323, PHY 324. Must be passed with grades of C or better.

PHY 371. Physiology of Exercise. 4 Credits.
Physiology of exercise, physical conditioning, and training; mechanisms and significance of these effects for health and performance.
Prereq: PHY 323, PHY 324. Must be passed with grades of C or better.

PHY 374. Clinical Electrocardiography and Exercise. 4 Credits.
Overview of pathophysiology, diagnostic testing, exercise prescription and rehabilitation of cardiovascular diseases. Incorporated throughout the course, students will learn the fundamentals of electrocardiography and how this tool is applied in both the diagnostic and rehabilitative settings.
Prereq: PHY 371. Must be passed with grades of C or better.

PHY 375. Metabolism and Nutrition. 4 Credits.
Exploration of cellular, tissue, and whole body integrated metabolic processes as the basis of physiologic function. Integrating the metabolism of macronutrients at the cellular, tissue, and whole body systems level in the context of human growth, function, and disease.
Prereq: PHY 325, PHY 371. Must be passed with grades of C or better.

PHY 381. Biomechanics. 4 Credits.
Fundamental principles of physics applied to the analysis of human movement. Emphasis on developing abilities to analyze human movement quantitatively.
Prereq: PHY 323, PHYS 201. Must be passed with grades of C or better.

PHY 399. Special Studies: [Topic]. 1-4 Credits.
Repeatable.
Prereq: PHY 325 or PHY 371. Must be passed with grades of C or better.

PHY 401. Research: [Topic]. 1-15 Credits.
Repeatable.

PHY 403. Thesis. 1-4 Credits.
For honors students during the terms in which they conduct research or write a thesis.

PHY 404. Internship: [Topic]. 1-16 Credits.
Repeatable. Field experience in an agency, institution, or business. Practice knowledge from courses; planning, organizing, directing, evaluating, and developing professional competence.

PHY 405. Reading and Conference: [Topic]. 1-15 Credits.
Repeatable. Reading and assignments in connection with other courses for extra credit. Honors readings.

PHY 406. Special Problems: [Topic]. 1-15 Credits.
Repeatable.

PHY 407. Seminar: [Topic]. 1-5 Credits.
Repeatable. Topics are offered regularly in such areas as health sciences, motor control, biomechanics, and physiology.

PHY 408. Workshop: [Topic]. 1-15 Credits.
Repeatable.

PHY 409. Practicum: [Topic]. 1-15 Credits.
Repeatable. Assist students learning anatomy or physiology in either the lecture or lab courses.

PHY 410. Experimental Course: [Topic]. 1-5 Credits.
Repeatable.
Prereq: PHY 325 or PHY 371. Must be passed with grades of C or better.

PHY 411. Scientific Teaching. 1 Credit.
For students currently completing the human anatomy and physiology core sequence; focuses on how people learn, evidence-based teaching practices, and strategies to improve student inclusion and representation.
Prereq: PHY 211, PHY 212.

PHY 412. Sleep Physiology. 4 Credits.
Fundamental principles of sleep and how physiology is affected by sleep.
Prereq: PHY 325 with a C or better.

PHY 413. Muscle Structure, Function, and Plasticity. 4 Credits.
Physiologic basis for skeletal muscle adaptation to increased and decreased use and injury. Emphasizes how structure dictates function relevant to rehabilitation.
Prereq: PHY 323, PHY 324. Must be passed with grades of C or better.

PHY 414. Muscle Metabolism. 4 Credits.
Metabolic basis for skeletal muscle adaptation to increased and decreased use, and injury models. Emphasizes interorgan communication; uses clinical models.
Prereq: PHY 371. Must be passed with grades of C or better.

PHY 420. Human Anatomy Dissection. 2 Credits.
Dissection of one region of a preserved donated human cadaver and preparation of the specimen for the PHY 321/PHY 323/PHY 325 laboratory experience. Students are accepted by application, which are due early February.
Prereq: PHY 323. Must be passed with grades of C or better.

PHY 422. Physiology of Obesity. 4 Credits.
Explores potential causes of the obesity epidemic, cellular mechanisms linking obesity to insulin resistance and metabolic diseases, and interventions in treatment of metabolic disease and obesity.
Prereq: PHY 325, PHY 371 with a C or better.

PHY 423. Physiology of Aging. 4 Credits.
Examines changes that occur to cells and organs in old age and the causes of age-related disease and dysfunction (cardiovascular disease, diabetes, osteoporosis, Alzheimer’s); interventions to increase longevity.
Prereq: PHY 325 with a C or better.

PHY 432. Neural Development. 4 Credits.
Exploration of development of the cells in the nervous system. We will discuss the importance of “critical periods” in development and how interventions or dysfunction during critical periods can lead to neurodevelopmental disorders using the respiratory system as a model system.
Prereq: PHY 323, PHY 324. Must be passed with grades of C or better.
HPHY 433. Neurophysiology of Concussion. 4 Credits.
Investigate diagnosis, deficits, and treatment of mild traumatic brain injury and neurophysiological effects.
Prereq: HPHY 325, HPHY 333. Must be passed with grades of C or better.

HPHY 434. Movement Disorders. 4 Credits.
Discusses the clinical manifestations and underlying physiological mechanisms of selected movement disorders. Emphasizes the role of scientific experiment in diagnosis and treatment.
Prereq: HPHY 325, HPHY 333. Must be passed with grades of C or better.

HPHY 436. Clinical Neuroscience. 4 Credits.
This course covers neurological diseases and disorders from a neuroscience perspective. The focus will be on applying basic neuroscience principles to better understand clinical practices including patient diagnosis and treatments.
Prereq: HPHY 323 and 324 with a C or better.

HPHY 444. Clinical Anatomy. 4 Credits.
Through case-based learning, students have the opportunity to apply the knowledge of anatomy and physiology in the context of clinical practice and diagnosis.
Prereq: HPHY 325. Must be passed with grades of C or better.

HPHY 462. Therapeutic Techniques. 4 Credits.
Clinical application of therapeutic techniques including modalities and rehabilitation for soft-tissue orthopedic injuries. Offered alternate years.
Prereq: HPHY 362. Must be passed with grades of C or better.

HPHY 470. Environmental Physiology. 4 Credits.
Examination of physiological adaptations to acute and chronic exposure to extreme heat, cold, and high altitude.
Prereq: HPHY 371. Must be passed with grades of C or better.

HPHY 472. Science of Athletic Performance. 4 Credits.
Theoretical basis and practical application of modern physiological testing of cardiovascular and respiratory function with a focus on exercise and performance.
Prereq: HPHY 371. Must be passed with grades of C or better.

HPHY 473. High Altitude Physiology and Medicine. 4 Credits.
Explores major physiologic responses to high altitude (hypoxia), both adaptive and maladaptive, from systems to molecular level, as well as pathophysiologic conditions at high altitude. Offered alternate years.
Prereq: HPHY 325 and 371. Must be passed with grades of C or better.

HPHY 503. Thesis. 1-16 Credits.
Repeatable.

HPHY 507. Seminar: [Topic]. 1-5 Credits.
Repeatable. Topics are offered regularly in such areas as health sciences, motor control, biomechanics, and physiology.

HPHY 508. Workshop: [Topic]. 1-15 Credits.
Repeatable.

HPHY 510. Experimental Course: [Topic]. 1-5 Credits.
Repeatable.

HPHY 512. Sleep Physiology. 4 Credits.
Fundamental principles of sleep and how physiology is affected by sleep.

HPHY 513. Muscle Structure, Function, and Plasticity. 4 Credits.
Physiologic basis for skeletal muscle adaptation to increased and decreased use and injury. Emphasizes how structure dictates function relevant to rehabilitation.

HPHY 514. Muscle Metabolism. 4 Credits.
Metabolic basis for skeletal muscle adaptation to increased and decreased use, and injury models. Emphasizes interorgan communication; uses clinical models.

HPHY 520. Human Anatomy Dissection. 2 Credits.
Dissection of one region of a preserved donated human cadaver and preparation of the specimen for the HPHY 321/HPHY 323/HPHY 325 laboratory experience. Students are accepted by application, which are due early February.

HPHY 522. Physiology of Obesity. 4 Credits.
Explores potential causes of the obesity epidemic, cellular mechanisms linking obesity to insulin resistance and metabolic diseases, and interventions in treatment of metabolic disease and obesity.

HPHY 523. Physiology of Aging. 4 Credits.
Examines changes that occur to cells and organs in old age and the causes of age-related disease and dysfunction (cardiovascular disease, diabetes, osteoporosis, Alzheimer’s); interventions to increase longevity.

HPHY 532. Neural Development. 4 Credits.
Exploration of development of the cells in the nervous system. We will discuss the importance of “critical periods” in development and how interventions or dysfunction during critical periods can lead to neurodevelopmental disorders using the respiratory system as a model system.

HPHY 533. Neurophysiology of Concussion. 4 Credits.
Investigate diagnosis, deficits, and treatment of mild traumatic brain injury and neurophysiological effects.

HPHY 534. Movement Disorders. 4 Credits.
Discusses the clinical manifestations and underlying physiological mechanisms of selected movement disorders. Emphasizes the role of scientific experiment in diagnosis and treatment.

HPHY 536. Clinical Neuroscience. 4 Credits.
This course covers neurological diseases and disorders from a neuroscience perspective. The focus will be on applying basic neuroscience principles to better understand clinical practices including patient diagnosis and treatments.

HPHY 570. Environmental Physiology. 4 Credits.
Examination of physiological adaptations to acute and chronic exposure to extreme heat, cold, and high altitude.

HPHY 573. High Altitude Physiology and Medicine. 4 Credits.
Explores major physiologic responses to high altitude (hypoxia), both adaptive and maladaptive, from systems to molecular level, as well as pathophysiologic conditions at high altitude. Offered alternate years.

HPHY 601. Research: [Topic]. 1-16 Credits.
Repeatable.

HPHY 602. Supervised College Teaching. 1-5 Credits.
Repeatable.

HPHY 603. Dissertation. 1-16 Credits.
Repeatable.

HPHY 605. Reading and Conference: [Topic]. 1-15 Credits.
Repeatable.

HPHY 606. Special Problems: [Topic]. 1-16 Credits.
Repeatable. Selected problems in the field of human physiology.

HPHY 607. Seminar: [Topic]. 1-9 Credits.
Repeatable. Topics are offered regularly in such areas as health sciences, motor control, biomechanics, and physiology.
HPHY 608. Workshop: [Topic]. 1-15 Credits.
Repeatable.

HPHY 609. Practicum: [Topic]. 1-15 Credits.
Repeatable.

HPHY 610. Experimental Course: [Topic]. 1-5 Credits.
Repeatable.

HPHY 611. Professional Skills I: Effective Teaching. 1 Credit.
Development of professional skills for academic careers related to human physiology. Sequence with HPHY 612, 613.

HPHY 612. Professional Skills II: Responsible Research. 1 Credit.
Development of professional skills for academic careers related to human physiology. Sequence with HPHY 611, 613.

HPHY 613. Professional Skills III: Career Development. 1 Credit.
Development of professional skills for academic careers related to human physiology. Sequence with HPHY 611, 612.

HPHY 621. Systems Physiology I. 4 Credits.
Advanced overview of neural physiology, neural control of human movement, and the biomechanical constraints underlying that control. Sequence with 622, 623.

HPHY 622. Systems Physiology II. 4 Credits.
Advanced overview of cardiovascular physiology and skeletal muscle cell physiology and metabolism. Series with HPHY 621, 623.

HPHY 623. Systems Physiology III. 4 Credits.
Advanced overview of renal and respiratory physiology. Series with HPHY 621, 622.

HPHY 631. Human Performance and Sports Products. 3 Credits.
Exploration of sciences of human performance: physiology and kinesiology, which inform the Sports Product Industry at the level of product development, product design and marketing. Available to non-majors only.

HPHY 631M. Human Performance and Sports Products. 3 Credits.
Exploration of sciences of human performance: physiology and kinesiology, which inform the Sports Product Industry at the level of product development, product design and marketing.

HPHY 632. Human Biomechanics and Sports Product Design. 2 Credits.
Exploration of sciences of human biomechanics, which inform the Sports Product Industry at the level of product development, product design and marketing.

HPHY 660. Basic Science in Clinical Decisions. 4 Credits.
Literature-based investigation into the basic science and clinical research underlying clinical decisions in athletic medicine.

HPHY 661. Manual Therapy: Movement Patterns, Core Stability. 2 Credits.
Advanced skills in proprioceptive neuromuscular facilitation (PNF) movement patterns, and both pilates principles and manual therapy to improve core stability. For certified athletic trainers. Offered alternate years.

Advanced skills in muscle energy, mobilization, and trigger-point release techniques for the spine and lower quadrant. For certified athletic trainers. Offered alternate years.

HPHY 669. The Female Athlete. 4 Credits.
Literature-based investigation of the unique anatomy and physiology, as well as social-cultural issues, of the female athlete related to sports medicine.

HPHY 670. Advanced Respiratory Physiology. 4 Credits.
Explores advanced concepts in respiratory physiology; includes exercise adaptations and examples of pathophysiologic. Offered alternate years. Prereq: HPHY 623.

HPHY 671. Therapeutic Restoration of Biomotor Abilities. 3 Credits.
Exploration of advanced rehabilitation techniques for athletic trainers, including advanced program design, evaluation, and movement-sport analysis.
Pre- or coreq: certification as an athletic trainer or physical therapist.

HPHY 676. Human Cardiovascular Control. 4 Credits.
Cardiovascular physiology, including central control of blood pressure and flow regulation. An integrative approach toward how the cardiovascular system is coordinated with overall body function. Offered alternate years.

HPHY 684. Kinematics of Human Movement. 4 Credits.
Theory and application of kinematic analysis of human motion. Emphasis on 2D and 3D kinematics, including data collection, analysis and modeling. Offered alternate years.

HPHY 685. Kinetics of Human Movement. 4 Credits.
Experimental methods and mechanical theories associated with the analysis of joint forces and movements during human motion. Offered alternate years.

HPHY 687. Systems Physiology I. 4 Credits.
Advanced overview of neural physiology, neural control of human movement, and the biomechanical constraints underlying that control. Sequence with 622, 623.

HPHY 688. Systems Physiology II. 4 Credits.
Advanced overview of cardiovascular physiology and skeletal muscle cell physiology and metabolism. Series with HPHY 621, 623.

HPHY 689. Systems Physiology III. 4 Credits.
Advanced overview of renal and respiratory physiology. Series with HPHY 621, 622.

HPHY 690. Human Performance and Sports Products. 3 Credits.
Exploration of sciences of human performance: physiology and kinesiology, which inform the Sports Product Industry at the level of product development, product design and marketing. Available to non-majors only.

HPHY 691. Human Biomechanics and Sports Product Design. 2 Credits.
Exploration of sciences of human biomechanics, which inform the Sports Product Industry at the level of product development, product design and marketing.

HPHY 692. Basic Science in Clinical Decisions. 4 Credits.
Literature-based investigation into the basic science and clinical research underlying clinical decisions in athletic medicine.