Biomedical Science, Ph.D.

Molecular Medicine

The Doctor of Philosophy in biomedical science with a molecular medicine subprogram provides interdisciplinary training in the concepts and methodologies fundamental to the investigation of biological processes and molecular mechanisms that relate to human disease. The Ph.D. requires a minimum of 72 s.h. of graduate credit. Students must maintain a cumulative g.p.a. of at least 3.00 to earn the degree.

Students enter the molecular medicine subprogram through the Biomedical Science Program (BSP). The BSP is designed to provide students maximum flexibility during the first year of graduate studies to take a course of study compatible with several programs while completing research rotations. At the end of the first year, students choose a subprogram affiliation.

The curriculum is a sequence of required and elective courses, which provides students with broad exposure to areas including molecular biology, cell biology, biochemistry, and integrative sciences. It ensures a comprehensive exposure to conceptual and experimental aspects of molecular and cellular biology and of translational studies. Sufficient flexibility is provided so that students can adapt the program to permit specialization in their own area of interest. Faculty members are involved in a variety of research projects involving molecular and cellular biology and molecular medicine.

The Ph.D. in biomedical science with a molecular medicine subprogram requires the following coursework.

Typical Curriculum

First Year

See the Overview (p. 1) at the beginning of the Ph.D. in biomedical science section of the Catalog for a typical first-year schedule.

Second Year

Students select coursework from the following three track areas: metabolic disorders, cardiovascular biology, and molecular and cellular medicine (general).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMED:7270</td>
<td>Scholarly Integrity/ Responsible Conduct of Research I</td>
<td>0</td>
</tr>
<tr>
<td>MMED:6280</td>
<td>Critical Thinking in Molecular Medicine</td>
<td>1</td>
</tr>
<tr>
<td>MMED:7290</td>
<td>Seminars in Molecular Medicine</td>
<td>1</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>1-3</td>
</tr>
</tbody>
</table>

Students select coursework from the following three track areas: metabolic disorders, cardiovascular biology, and molecular and cellular medicine (general).

<table>
<thead>
<tr>
<th>Metabolic Disorders</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMED:6230</td>
<td>Pathogenesis of Metabolic and Cardiovascular Disorders</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MMED:6280</td>
<td>Critical Thinking in Molecular Medicine</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MMED:7310</td>
<td>Translational Medicine Education Rounds (taken fall and spring semesters)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BIOC:7253</td>
<td>Metabolism I</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BIOC:7255</td>
<td>Metabolism II</td>
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<td></td>
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Cardiovascular Biology

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>MMED:6230</td>
<td>Pathogenesis of Metabolic and Cardiovascular Disorders</td>
<td>3</td>
</tr>
<tr>
<td>MMED:6280</td>
<td>Critical Thinking in Molecular Medicine</td>
<td>1</td>
</tr>
<tr>
<td>MMED:7310</td>
<td>Translational Medicine Education Rounds (taken fall and spring semesters)</td>
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</tbody>
</table>

Elective | 3 |

Molecular and Cellular Medicine (General)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMED:6220/ACB:6220/MPB:6220</td>
<td>Mechanisms of Cellular Organization</td>
<td>3</td>
</tr>
<tr>
<td>MMED:6280</td>
<td>Critical Thinking in Molecular Medicine</td>
<td>1</td>
</tr>
<tr>
<td>MMED:7310</td>
<td>Translational Medicine Education Rounds (taken fall and spring semesters)</td>
<td>1</td>
</tr>
</tbody>
</table>

Related coursework from list in the molecular medicine Graduate Student Guidelines | 2 |

3 s.h. from these:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMED:3310/BIOC:3310/CBIO:3310</td>
<td>Practical Data Science and Bioinformatics</td>
<td>3</td>
</tr>
<tr>
<td>MMED:6225/ACB:6225/MPB:6225</td>
<td>Growth Factor Receptor Signaling</td>
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</tr>
<tr>
<td>MMED:6226/ACB:6226/MPB:6226</td>
<td>Cell Cycle Control</td>
<td>1</td>
</tr>
<tr>
<td>MMED:6227/ACB:6227/MPB:6227</td>
<td>Cell Fate Decisions (elective, 1s.h. maximum)</td>
<td>1</td>
</tr>
</tbody>
</table>

Elective | 1 |

Additional Requirements

Laboratory Rotations

To ensure that students obtain early involvement in laboratory research, they are required to register for research credits and complete three laboratory rotations during their first year of graduate study. In general, these rotations are in laboratories of three different molecular medicine faculty members. In some cases, if approved by the molecular medicine program,
students may be allowed to complete two of their rotations in
the same laboratory.

Teaching
Students are required to complete a teaching requirement (3
s.h.). They may teach in a combination of 1 or 2 s.h. courses,
or one 3 s.h. course. This teaching requirement must be met
prior to the final dissertation defense and graduation. It is
recommended that teaching occur in the third year following
completion of the comprehensive examination.

Publication Requirements
Students are required to have a minimum of one first-author
publication in a peer-reviewed journal. The article must be
formally accepted and be in-press status or be published prior
to graduation. A co-first-authored, peer-reviewed publication
will count toward this requirement.

External Fellowship Application
Requirement
Students are required to submit a fellowship to an external
funding agency (i.e., National Institutes of Health, American
Heart Association) within one year of completing their
comprehensive examination or by a date that is mutually
agreed upon by the student, the dissertation advisor, and the
molecular medicine program.

Comprehensive Examination
Students are expected to complete the comprehensive
examination, both written and oral components, before
the beginning of their third year. The preliminary specific
aims document can be submitted to the comprehensive
examination committee any time after approval of the
dissertation plan, but must be submitted before April 1. The
committee evaluation of the specific aims will be returned to
the student within one week. A rejected specific aims must be
revised and resubmitted within three weeks. The committee
then has one week to evaluate the resubmitted specific aims.
The specific aims must be accepted by a majority vote of the
committee before a student can proceed with development of
a full proposal. Only two rounds of submission are allowed.
Following acceptance of the specific aims, a student must
submit the written proposal within six weeks. The committee
has two weeks to review the written document. The oral
presentation to defend the written proposal should be
scheduled as soon after the two weeks as possible or at
the convenience of the committee. It is expected that all
examinations will be completed by July 15, in advance of the
end of the student's second year.
The detailed Molecular Medicine Graduate Student
Guidelines is located under Program Information on the
Molecular Medicine Program website.

Final Examination
The five-member thesis committee serves as an advisory
body for preparation of the thesis. It is expected that a
student meet with the committee annually, although the
candidate, thesis advisor, or the committee can request a
meeting at any time. The final examination takes the form of
a seminar presented to the program followed by a final thesis
defense with committee members. The student is required to
present a complete copy of the thesis to the thesis committee
members at least two weeks prior to the final defense date.

Combined Programs
Ph.D./M.D.
Students may work toward the Doctor of Medicine degree
and a Ph.D. in biomedical science (molecular medicine
subprogram) in a combined degree program offered by
the Graduate College and the Carver College of Medicine.
Applicants must be admitted to both programs before they
may be admitted to the combined degree program. See
the Medical Scientist Training Program (Carver College of
Medicine) in the Catalog.