INFECTION, IMMUNITY, AND INFLAMMATION — M.S., PH.D.

Program director
Kimberly Payne

Associate program director
Mark Johnson

The core curriculum provides a broad background in molecular biology, immunology, and medical microbiology and infectious diseases. Advanced courses allow each student to fully develop an area of interest. Research strengths of the program include: signal transduction in bacteria, molecular genetics of virulence in bacteria, mechanisms of oxidative stress resistance, mechanisms of cell death, cellular and tumor immunology, normal and malignant immune cell development, autoimmunity, chaperonins and protein folding, mechanisms of posttranslational modification, and DNA restriction modification.

The thesis or research Master of Science degree provides training for individuals who will become technicians involved in biomedical research in universities or in the biotechnology industry, and for medical technologists seeking specialized research training. The non-thesis Master of Science degree provides content appropriate for medical technologists preparing for the specialist in microbiology certification; for secondary teachers seeking advanced training in areas such as molecular biology, immunology, or microbiology; and for students seeking admission to professional schools, such as medicine or dentistry.

The Doctor of Philosophy degree is designed to prepare students for careers in independent research, and teaching in a university, clinical, or biotechnology environment. Doctoral degree students are expected to develop creativity and independence in addition to technical skills.

Program learning outcomes

By the end of the program, the graduate should be able to:

1. Demonstrate a broad knowledge of the biomedical sciences.
2. Demonstrate subject mastery in molecular, cellular, and integrative aspects of microbiology and immunity/inflammation.
3. Interpret the current literature in microbiology and immunity/inflammation.
4. Make original contributions to the body of biomedical knowledge.
5. Exhibit the principles of scientific and professional ethics.
6. Demonstrate the process of applying for external funding.*

*This learning outcome is not applicable to M.S. degree students.

M.S. requirements

A minimum of 45 units is required for the M.S. degree, as detailed in the table below. Two options, a research track and a course work track, are available. Students must maintain a G.P.A. of at least 3.0. Students must adhere to all University and program policies as published in the Student Handbook, University CATALOG, or "Student Guide." Policies and requirements are subject to change.

Basic science core

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBGS 501</td>
<td>Biomedical Communication and Integrity</td>
<td>2</td>
</tr>
<tr>
<td>IBGS 502</td>
<td>Biomedical Information and Statistics</td>
<td>2</td>
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</tbody>
</table>

Degree completion options

Coursework track:
Electives (Choose 11 additional units from available electives listed below or from program-specific courses above)

Research track:
Elective (3)
IBGS 697 Research (5 units)
IBGS 698 Thesis (1-3 units)

Total Units 45

Available Electives

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>ANAT 548</td>
<td>Introductory Flow Cytometry</td>
<td>3</td>
</tr>
<tr>
<td>MICR 515</td>
<td>Introduction to Bioinformatics and Genomics</td>
<td>2</td>
</tr>
<tr>
<td>MICR 521</td>
<td>Medical Microbiology</td>
<td>2</td>
</tr>
<tr>
<td>MICR 530</td>
<td>Immunology</td>
<td>3</td>
</tr>
<tr>
<td>MICR 540</td>
<td>Physiology and Molecular Genetics of Microbes</td>
<td>2</td>
</tr>
<tr>
<td>MICR 570</td>
<td>Mechanisms of Microbial Pathogenesis</td>
<td>2</td>
</tr>
<tr>
<td>MICR 624</td>
<td>Special Problems in Microbiology</td>
<td>2</td>
</tr>
<tr>
<td>MICR 625</td>
<td>Independent Study in Microbiology Literature</td>
<td>2</td>
</tr>
</tbody>
</table>

Research track:
IBGS 511 Cellular Mechanisms and Integrated Systems I 6
IBGS 512 Cellular Mechanisms and Integrated Systems II 6
IBGS 522 Cellular Mechanisms and Integrated Systems II 2
IBGS 523 Cellular Mechanisms and Integrated Systems III 2
IBGS 511 Journal Club
IBGS 512 Journal Club
IBGS 522 Journal Club

Seminars (all required)

IBGS 604 Introduction to Integrative Biology Presentation Seminar 1
IBGS 605 Integrative Biology Presentation Seminar 1
IBGS 607 Integrated Biomedical Graduate Studies Seminar 1
IBGS 698 Thesis (1-3 units)

Religion

REL, ____ Graduate-level religion course (RELE, RELR, or RELT) 3

Electives (Choose 11 additional units from available electives listed below or from program-specific courses above)

1. Registration and attendance required every quarter in residence, but units do not count toward total required for graduation.
2. Must take at least 3 units of course work with a clear microbiology focus.
3. Must take at least 3 units with a clear immunology focus.

Noncourse requirements

Course work track: a comprehensive written examination over the graduate course work in lieu of preparing a thesis.

Research track: pass an oral examination given by his/her graduate guidance committee after the thesis has been completed.
Normal time to complete the program
Two (2) years—based on full-time enrollment; part time permitted

Comparison
See the comparison (http://llucatalog.llu.edu/medicine/infection-immunity-and-inflammation/comparison) of the M.S. and Ph.D. degree programs.

Ph.D. requirements
For the Ph.D. degree, students must complete a minimum of 60 units—as detailed in the table below—and must maintain a G.P.A. of at least 3.0. Students must adhere to all University and program policies as published in the Student Handbook, University CATALOG, or "Student Guide." Policies and requirements are subject to change.

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<tr>
<td>IBGS 502</td>
<td>Biomedical Information and Statistics</td>
<td>2</td>
</tr>
<tr>
<td>IBGS 503</td>
<td>Biomedical Grant Writing</td>
<td>2</td>
</tr>
<tr>
<td>IBGS 511</td>
<td>Cellular Mechanisms and Integrated Systems I</td>
<td>6</td>
</tr>
<tr>
<td>IBGS 512</td>
<td>Cellular Mechanisms and Integrated Systems II</td>
<td>6</td>
</tr>
<tr>
<td>IBGS 522</td>
<td>Cellular Mechanisms and Integrated Systems II</td>
<td>2</td>
</tr>
<tr>
<td>IBGS 523</td>
<td>Cellular Mechanisms and Integrated Systems III</td>
<td>2</td>
</tr>
<tr>
<td>IBGS 604</td>
<td>Introduction to Integrative Biology Presentation Seminar</td>
<td>1</td>
</tr>
<tr>
<td>IBGS 605</td>
<td>Integrative Biology Presentation Seminar</td>
<td>2</td>
</tr>
<tr>
<td>IBGS 607</td>
<td>Integrated Biomedical Graduate Studies Seminar</td>
<td>0</td>
</tr>
<tr>
<td>RELE 525</td>
<td>Ethics for Scientists</td>
<td>3</td>
</tr>
<tr>
<td>RELR 588</td>
<td>Personal and Family Wholeness</td>
<td>3</td>
</tr>
<tr>
<td>RELT 617</td>
<td>Seminar in Religion and the Sciences</td>
<td>3</td>
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</tbody>
</table>
| Program specific courses
Choose from the following: 12 |
| ANAT 548    | Introductory Flow Cytometry                       | 3     |
| MICR 515    | Introduction to Bioinformatics and Genomics       |       |
| MICR 521    | Medical Microbiology                              | 2     |
| MICR 530    | Immunology                                        | 3     |
| MICR 540    | Physiology and Molecular Genetics of Microbes     | 2     |
| MICR 570    | Mechanisms of Microbial Pathogenesis              | 2     |
| MICR 624    | Special Problems in Microbiology                 |       |
| MICR 625    | Independent Study in Microbiology Literature      | (2-4) |
| Research    |
| IBGS 696    | Research Rotations (1)                            | 2     |
| MICR 697    | Research (1-7)                                    | 12    |
| IBGS 699    | Dissertation (1-5)                                | 2-5   |
| Total Units |                                                   | 62    |

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<tr>
<td>ANAT 507</td>
<td>Stem Cell Biology and Medicine</td>
<td>4</td>
</tr>
<tr>
<td>BCHM 515</td>
<td>Introduction to Bioinformatics</td>
<td>2</td>
</tr>
<tr>
<td>BCHM 544</td>
<td>Advanced Topics in Biochemistry</td>
<td>2-4</td>
</tr>
<tr>
<td>IBGS 525</td>
<td>Translational Research Training</td>
<td>2</td>
</tr>
</tbody>
</table>

1 Registration and attendance required every quarter in residence, but units do not count toward total required for graduation.
2 Must take at least 3 units of course work with a clear microbiology focus.
3 Must take at least 3 units with a clear immunology focus.

Normal time to complete the program
Five (5) years—based on full-time enrollment; part time permitted

Comparison
See the comparison (http://llucatalog.llu.edu/medicine/infection-immunity-and-inflammation/comparison) of the M.S. and Ph.D. degree programs.