IMMUNOLOGY AND INFECTIOUS DISEASE, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

Immunology is the study of how animals and humans protect themselves from pathogens. Understanding basic mechanisms of immunity provides insights into how blood cells develop and how pathogens are recognized and attacked. Furthermore, understanding the concepts behind immunology is necessary for drug and vaccine design. Dysregulation of the processes that regulate immunity can contribute to uncontrolled inflammation, tissue destruction, autoimmunity, immunodeficiencies, leukemia and related cancers. Immunology includes a broad range of disciplines including but not limited to microbiology, virology, animal health, genetics, biochemistry, molecular and cell biology. Students enrolled in the Immunology and Infectious Disease Major will develop and understanding of normal immune responses to bacterial, fungal, and viral agents and appreciate the potential pathological outcomes of these responses. Students will learn about events that shape the immune response; the general biology of pathogens and the mechanisms by which they cause disease. In addition, basic skills in microbiology, molecular biology and biochemistry will be acquired. Students completing a B.S. degree in Immunology and Infectious Disease will be well prepared for veterinary, medical or other professional schools, Ph.D. graduate training in a wide variety of areas including immunology, microbiology, virology, molecular medicine, animal science, molecular biology and biochemistry or highly competitive jobs as research technicians, laboratory assistants or sales representatives with a pharmaceutical company.

What is Immunology and Infectious Disease?

Immunology and Infectious Disease is the study of how the body copes with bacterial, viral, or parasitic infections, cancer, autoimmune disease and other diseases of the immune system. The immune system protects us from infection through a complex network of cells and tissues designed to fight invading pathogens. Immunology is the study of the response of the immune system to bacterial, viral or parasitic infections. It is also the study of diseases caused by disorders of the immune system. Autoimmune diseases are diseases that cause your immune system to attack your own body. Immunodeficiency disease is a result of failure of the immune system to function in its normal capacity. Allergy is a result of the immune system responding to substances that are not usually harmful. Immunology also covers the development of the immune system as well as the malignant growth of immune cells, and the epidemiology of infectious disease.

You Might Like this Program If...

- You are interested in studying mechanisms of human disease progression at the molecular, cellular, and whole organism levels, and how these diseases are impacted by components of the immune system
- You are looking for opportunities to perform research in the laboratories of faculty in areas of immune cell development, inflammation, autoimmune disease, cancer biology, and infectious disease

Entrance to Major

In order to be eligible for entrance to the Immunology and Infectious Disease major, a student must have:

1. attained at least a 2.00 cumulative grade point average;
2. completed BIOL 110, BIOL 230W, BIOL 220W or BIOL 240W, CHEM 110, CHEM 111, CHEM 112, CHEM 113, MATH 140, MATH 141;
3. earned a grade of C or better in each of these courses.

Degree Requirements

For the Bachelor of Science degree in Immunology and Infectious Disease, a minimum of 124 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Electives</td>
<td>3-5</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>89-91</td>
</tr>
</tbody>
</table>

15 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses.

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains

- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- Inter-Domain or Approved Linked Courses: 6 credits
University Degree Requirements

First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement
6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44. Students should consult with their college or department adviser for information on specific credit requirements.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 250</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 251</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>VBSC 448</td>
<td>Current Topics in Immunology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
<td>4</td>
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</tbody>
</table>

BIOL 230W  Biology: Molecules and Cells  4
BMB 401  General Biochemistry  3
BMB 402  General Biochemistry  3
CHEM 110  Chemical Principles I  3
CHEM 111  Experimental Chemistry I  1
CHEM 112  Chemical Principles II  3
CHEM 113  Experimental Chemistry II  1
MATH 140  Calculus With Analytic Geometry I  4
MATH 141  Calculus with Analytic Geometry II  4
MICRB 201  Introductory Microbiology  3
MICRB 202  Introductory Microbiology Laboratory  2
MICRB 410  Principles of Immunology  3
VBSC 211  The Immune System and Disease  3

Additional Courses
Select 3-4 credits of the following:

- STAT 200  Elementary Statistics
- STAT 240  Introduction to Biometry
- STAT 250  Introduction to Biostatistics

Additional Courses: Require a grade of C or better

- BIOL 220W  Biology: Populations and Communities 4
- or BIOL 240W  Biology: Function and Development of Organisms 4
- VBSC 444  Epidemiology of Infectious Diseases 3
- or BBH/HPA 440  Principles of Epidemiology

Select 10-11 credits of the following:

- VBSC 418  Bacterial Pathogenesis
- VBSC/MICRB/  Advanced Immunology: Signaling in the Immune System 4
- BMB 432  System
- VBSC/MICRB 435  Viral Pathogenesis 4
- VBSC 445  Molecular Epidemiology of Infectious Diseases 4
- VBSC 451  Immunotoxicology of Drugs and Chemicals

Supporting Courses and Related Areas

Supporting Courses and Related Areas: Require a grade of C or better
Select 9 credits of 400-level courses from departmental list 9

Program Learning Objectives
1. Students will be able to read the scientific literature and write critical reviews in the Immunology and Infectious Disease discipline.
2. Students will be able to present and discuss scientific data and analysis in the field of Immunology and Infectious Disease.
3. Students will be familiar with potential careers in biomedical science and be prepared to apply for jobs or professional schools.

Academic Advising
The objectives of the university’s academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The
advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy)

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814-863-0128
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**Suggested Academic Plan**
The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2019-20 academic year. To access previous years' suggested academic plans, please visit the archive (http://bulletins.psu.edu/undergraduate/archive) to view the appropriate Undergraduate Bulletin edition (Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin).

**University Park Campus and Altoona Campus**
The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessibile in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
<td>VBSC 50 (or First Year Seminar)</td>
<td>3 ENGL 15, 30, or ESL 15††</td>
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<tr>
<td></td>
<td>BIOL 110††</td>
<td>4 BIOL 220W or 240W§</td>
<td>4</td>
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<tr>
<td></td>
<td>CHEM 110††</td>
<td>3 CHEM 112*††</td>
<td>3</td>
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<td></td>
<td>CHEM 111††</td>
<td>1 CHEM 113*††</td>
<td>1</td>
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<tr>
<td></td>
<td>MATH 140*††</td>
<td>4 MATH 141*††</td>
<td>4</td>
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<tr>
<td></td>
<td>General Education Course</td>
<td>3 General Education Course</td>
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<th>Second Year</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
<td>BIOL 230W§</td>
<td>4 VBSC 211*</td>
<td>3</td>
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<td></td>
<td>PHYS 250</td>
<td>4 PHYS 251</td>
<td>4</td>
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<td></td>
<td>CHEM 210</td>
<td>3 CHEM 212</td>
<td>3</td>
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<tr>
<td></td>
<td>CAS 100, 100A, 100B, or 100C†</td>
<td>3 CHEM 213</td>
<td>2</td>
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<tr>
<td></td>
<td>General Education Course (GHW)</td>
<td>1.5 MICRB 201*</td>
<td>3</td>
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<td><strong>15.5</strong></td>
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<th>Third Year</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
<td>BMB 401*</td>
<td>3 BMB 402*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MICRB 410*</td>
<td>3 VBSC 444 or HPA 440*</td>
<td>3</td>
</tr>
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</table>

| STAT 240, 200, or 250 | 3-4 ENGL 202C†† | 3 |
| MICRB 202* | 2 Elective or Supporting Course | 3 |
| Supporting Course 400-level* | 3 General Education Course | 3 |
|            | General Education Course (GHW) | 1.5 |
|            | **14-15** | **16.5** | |

<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
<td>VBSC 435, 445, or 451*</td>
<td>3 VBSC 418*</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>VBSC 435, 445, or 451*</td>
<td>3 VBSC 432*</td>
<td>3</td>
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<tr>
<td></td>
<td>General Education Course</td>
<td>3 VBSC 448</td>
<td>3</td>
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<tr>
<td></td>
<td>Supporting Course 400-level*</td>
<td>3 General Education Course</td>
<td>3</td>
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<tr>
<td></td>
<td>Elective or Supporting Course</td>
<td>3 Supporting Course 400-level*</td>
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<td><strong>15</strong></td>
<td><strong>14</strong></td>
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</table>

**University Requirements and General Education Notes:**
US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).
W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.
GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of ‘C’ or better.
Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.
All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

**Advising Note:**
**Electives and Supporting Courses** – Supporting courses are 400-level courses chosen from a department-approved list or approved by the Program Coordinator. Students must take 9 credits of supporting courses (all of which must have a grade of C or better). Elective credits may be used to earn a minor, usually commencing in the fifth semester. Please consult with your academic adviser for planning.
Commonwealth Campuses except Altoona Campus

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Career Paths

The Immunology and Infectious Disease major provides excellent preparation for a wide variety of careers in industry, government agencies, or academia, or for medical school, veterinary school, or graduate programs in any area of the biomedical sciences. Concern over bioweapons and emerging infectious diseases means high demand for specialists. Our major in Immunology and Infectious Disease is one of only a handful of such programs in the United States. Graduates distinguish themselves with focused courses in immunology and epidemiology while retaining the freedom to choose from a wide variety of courses in biomedicine and biotechnology.

Careers

Thanks to the specialization students can obtain in immunology and epidemiology, there are plentiful employment opportunities for graduates after four years. Some of these opportunities include research positions in biotechnology or pharmaceutical firms, government or international health agencies, and academic research laboratories. Students should recognize, however, that professional advancement in research-oriented careers is less realistic without an advanced degree. Many students choose to get experience for a few years in entry-level positions, and then return to master's and/or doctoral studies.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE IMMUNOLOGY AND INFECTIOUS DISEASE PROGRAM (http://vbs.psu.edu/majors/iid/careers)

Opportunities for Graduate Studies

The direct relevance of the course work to human health strongly attracts students interested in medicine and related fields. The Immunology and Infectious Disease major provides strong preparation for further studies in medical school, veterinary school, pharmacy school, or school of public health. The program also helps prepare students for graduate studies in the biomedical sciences. More than half of the students in the
Immunology and Infectious Disease major obtain further education in one of these fields.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (http://vbs.psu.edu/majors/iid/careers)

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