

Immunology

Overview

The UAB Undergraduate Immunology Program was established in 2016 as a joint program between the Department of Microbiology in the Heersink School of Medicine and the Department of Biology in the College of Arts and Sciences. The goal of the Immunology Major is to insure that undergraduates acquire knowledge in the fundamental aspects of Immunology, including the cells, organs, and tissues that comprise the immune system and how the system functions as a whole to protect humans against infectious diseases. The science of Immunology is multidisciplinary and encompasses the study of both normal processes that confer protection and pathophysiological processes that cause disease. Normal processes include the response to microbial pathogens, vaccines, and cancer, which confer "immunity". Abnormal functions of the immune system contribute to significant disease processes and include asthma/allergy, autoimmunity, inflammatory syndromes (cancer, diabetes, heart disease, chronic neurological diseases), immunodeficiencies (both congenital and acquired), and transplant rejection.

The Undergraduate Immunology Program will provide students with a solid foundation in the core sciences, including chemistry, physics, and biology. Students will be required to take inorganic, organic, and biochemistry, as well as introductory biology, genetics, and the biology of microorganisms. Because the Undergraduate Immunology Program has a strong focus on these core sciences, majors will have the necessary foundation upon which to learn the principles of the immune system with respect to its normal and pathophysiological function. Moreover, because the Undergraduate Immunology Program requires students to take the core sciences as part of their curriculum, they will meet the prerequisites for entry into graduate and professional schools.

The Undergraduate Immunology Program and its faculty will accomplish the goals of the program through four interrelated mechanisms. First, students will be provided an outstanding academic and intellectual foundation through their coursework in biology, chemistry, physics, mathematics, and immunology. Second, students will be immersed in a laboratory research setting where they will learn state-of-the-art research techniques and methodologies that will enable them to address important questions in Immunology through one-on-one interactions with faculty mentors and research laboratory personnel. Third, students will be able to gain skills and knowledge related to the scientific method, critical thinking, problem solving, data analysis and scientific communication (both oral and written) that will allow them to become an integral member of a research team and to present their work at poster sessions at local, regional and national meetings. Fourth, students will be able to access academic and career counseling and determine the career path that is ideally suited to their interests, as well as to identify professional or graduate programs and how best to prepare to be highly competitive for entrance into such programs.

The Undergraduate Immunology Program is designed to prepare graduates to pursue careers in research or health-related professions. Successful graduates will be competitive for acceptance into highly competitive graduate or professional degree programs that will enable them to become accomplished scientists, clinicians and health-care professionals who will contribute to efforts to elucidate the function of the immune system as it relates to health and disease. Graduates will be at the forefront of efforts to fight emerging infectious diseases, to address

global health problems, to develop new vaccines, or to find treatments for chronic diseases, including cancer, autoimmunity or asthma.

Admissions

The Undergraduate Immunology Program is designed for graduating high school seniors and college freshmen and sophomores with an outstanding academic record and the desire to pursue a career in biomedical research, medicine or the health professions. Successful applicants to the Program should meet the admissions criteria below.

High school students with a GPA of 3.5 or better and an ACT score of 28 or better will be considered for immediate acceptance into the Immunology Program. High school students who do not meet these requirements may be accepted into the program as pre-immunology majors. Any student who is admitted as a pre-immunology major must have an overall GPA #3.0 after 24 credits of work at UAB, a GPA #3.25 in their Biology, Chemistry, Physics and Mathematics (MA 105 and higher) coursework, and have taken a freshman year curriculum that is compatible with the Program.

Current UAB students and transfer students from other institutions who are freshmen or sophomores (non-direct admits) may select Immunology for their major, but must have an overall GPA #3.0 and must have demonstrated excellent academic performance in science/mathematics courses and have a GPA #3.25 in those courses.

Students must maintain an overall GPA #3.0 in order to remain in good academic standing in the Program. If a student's overall GPA falls below 3.0, they will have one semester to bring their overall grade to 3.0 or better.

Those who wish to apply to the Program should contact the Program Directors (uip@uab.edu) for additional information. The Director, Dr. Justement and the Co-Directors of the Program, Dr. Heather Bruns and Dr. Minako Vickery, are available to meet with high school students and their parents, or with current UAB students to discuss the program.

Advising and Information

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Major in Immunology

Requirements	Hours
Blazer Core Curriculum	41
Required courses: ^{1, 4, 5}	
Biology	
BY 123 Introductory Biology I	4
BY 124 Introductory Biology II	4
BY 210 Genetics	4
BY 271 Biology of Microorganisms	4
Chemistry	
CH 115 General Chemistry I & CH 116 and General Chemistry I Laboratory	4
CH 117 General Chemistry II & CH 118 and General Chemistry II Laboratory	4
CH 235 Organic Chemistry I & CH 236 and Organic Chemistry I Laboratory	4
CH 237 Organic Chemistry II & CH 238 and Organic Chemistry II Laboratory	4
CH 460 Fundamentals of Biochemistry	3
Physics ²	8
PH 201 College Physics I or PH 221 General Physics I	4
PH 202 College Physics II or PH 222 General Physics II	4
Mathematics	
MA 168 Mathematics of Biological Systems I or MA 125 Calculus I or MA 225 Calculus I - Honors	4
MA 180 Introduction to Statistics or PUH 250 Biostatistics	3
Immunology	
MIC 150 Current Topics In Immunology	1
MIC 250 Seminars in Immunology	1
MIC 275 Introduction to the Immune System or BY 440 Immunology	3
MIC 401 Foundations in Immunology: The Innate Immune System	3
MIC 402 Foundations in Immunology: The Adaptive Immune System	3
MIC 403 Foundations in Immunology: Microbial Pathogen-Immune System Interaction	3
MIC 404 Foundations in Immunology: Immunologically-Mediated Diseases	3
MIC 490 Immunology Thesis	0
Undergraduate Research ³	
MIC 398 Undergraduate Research in Immunology & Host Defense or MIC 498 Honors Research in Immunology and Host Defense	3
MIC 492 Undergraduate Research Seminar in Immunology and Host Defense	3

or MIC 499 Honors Research Seminar in Immunology and Host Defense

Total Hours **122**

- ¹ Students must also satisfactorily complete Area I (6 hrs), Area II (12 hrs), and Area IV (12 hrs) of the UAB Core Curriculum as well as a Freshman Year Experience (1 hr, normally CAS 112) with no grades lower than a C.
- ² Complete either trig-based or calculus-based physics series.
- ³ Undergraduate Research: Immunology Majors are required to complete a minimum of 6 semester credit hours of research under the direction of a faculty member beginning no later than the first semester of their junior year. However, qualified students may identify a mentor and begin conducting research as early as their freshman year. Course credit will be provided via MIC 398, MIC 492, MIC 498, or MIC 499. Students in the major are required to take 3 credit hours of either MIC 492 or MIC 499 to fulfill their undergraduate research requirement. As part of MIC 492 or MIC 499 students must complete a thesis and give one scientific presentation at UAB EXPO or equivalent. The completion of a thesis for other programs will fulfill this requirement.
- ⁴ Students must complete 17 hours of General Electives. The following are recommended but not required: BY 245, BY 330, BY 409, BY 433, BY 434, BY 437, BY 490, BY 491, MIC 400, GGSC 310, and GGSC 410
- ⁵ Seniors must take MIC 490 the semester in which they plan to graduate and complete all course assignments.

Academic Performance: Immunology majors must maintain an overall GPA of 3.0 or better to remain in the program. Majors will be allowed one semester to raise their GPA.

Capstone Requirement: Students may fulfill their Capstone requirement by taking either MIC 492 or MIC 499.

Honors Program in Immunology

Purpose

The Immunology Honors Program offers motivated students the opportunity to develop research, communication and responsible conduct of research skills in preparation for a professional career in research or the health professions.

Eligibility

To be accepted into the Immunology Honors Program, you must:

- Have completed at least 45 credit hours.
- Have a GPA 3.5 in BY, CH and MIC courses.
- Have a GPA 3.25 overall.
- Have already completed BY 123 and BY 123L, BY 124 and BY 124L, BY 210, CH 115/CH 116, and CH 117/CH 118.
- Have arranged with a faculty sponsor to do a research project and received approval from the Program Director.
- Honors Research in Immunology and Host Defense can also be taken as part of the University Honors Programs. Immunology majors generally enter their research labs in the fall semester of their junior year; however, they may begin their research work in the spring semester of their sophomore year or earlier with permission of the Program Directors.

Requirements.

To successfully complete the Immunology Honors Program, students will need to:

- Complete the required Occupational Health and Safety training courses.
- Take a minimum of 6 semester credit hours of MIC 498 Honors Research in Immunology and Host Defense. Each semester credit hour per term requires a minimum of 3 hours of laboratory work per week.
- Submit a formal research proposal by the end of the first semester of Honors Research. The proposal should include a synopsis of the proposed research incorporating an introduction, proposed methods, and relevant literature review.
- Take the Honors Research Seminar in Immunology and Host Defense (MIC 499) course during the junior or senior year. This course can be taken to fulfill the Capstone requirement.
- Complete a formal written report in the form of a scientific paper.
- Submit an oral or poster presentation at Biology Research Day or the UAB Expo during their junior or senior year. Under special circumstances, the poster may be presented at other times of the year pending approval of the Program Directors.

Immunology 4-Year Plan

This schedule does not account for University or Science and Technology Honors Programs.

Freshman

First Term	Hours	Second Term	Hours
EH 101 ¹		3 BY 123	4
CH 115 & CH 116		4 CH 117 & CH 118	4
CAS 112		3 EH 102 ¹	3
MA 125 or 225		4 MIC 150	1
Blazer Core course		3 Blazer Core course	3
		17	15

Sophomore

First Term	Hours	Second Term	Hours
BY 124 ²		4 BY 210	4
CH 235 & CH 236		4 CH 237 & CH 238	4
MIC 250		1 MIC 275 or BY 440 ³	3
Blazer Core course		3 Blazer Core course	3
Blazer Core course		3 General Elective Course	3
		15	17

Junior

First Term	Hours	Second Term	Hours
BY 271		4 MIC 398 or 498	3
MIC 401		3 MIC 402	3
PH 201 or 221		4 PH 202 or 222	4
Blazer Core course		3 Blazer Core course	3
General Elective Course		2 General Elective Course	3
		16	16

Senior

First Term	Hours	Second Term	Hours
MA 180 or PUH 250		3 CH 460	3
MIC 403		3 MIC 404	3

Blazer Core course	3 MIC 490 ⁵	0
General Elective Course	3 MIC 492 or 499	3
General Elective Course	3 General Elective Course	3
		12

Total credit hours: 123

- ¹ Students with AP credit for EH 101 may take EH 102 instead.
- ² Sometimes taken summer after freshman year
- ³ BY 440 requires permission of the program director.
- ⁴ Students must take a minimum of 6 credit hours of Undergraduate Research (3 credit hours of MIC 398 or MIC 498, and 3 credit hours of MIC 492 or MIC 499). Additional hours of MIC 398 MIC 498 may be taken to fulfill the General Elective requirement. 0-6 credit hours may be taken in any given semester.
- ⁵ Students should register for MIC 490 in the semester in which they plan to graduate.

Minor in Immunology

The immune system is vital for providing protection against infectious diseases and is essential for survival. With the recent global threat posed by the COVID-19 pandemic, the field of immunology has taken on new significance with respect to the development of technologies that rely on knowledge pertaining to the function of the immune system that has been translated into vaccines, therapeutic monoclonal antibodies and other interventions that have saved the lives of millions across the globe. At the same time, the immune system can cause significant morbidity and mortality if its response is misdirected or dysregulated, leading to autoimmune disease, allergy and asthma and a wide range of chronic diseases, including diabetes, heart disease chronic neurological disease and cancer, as a result of unchecked inflammation. Once again, understanding the cellular and molecular mechanisms that control the immune response has fostered the development of immunotherapies to treat autoimmune disease, allergies and most recently cancer. Indeed, recent advances in harnessing the immune response to fight cancer have resulted in tremendous success in treating this devastating disease and represent some of the most exciting scientific advances in the past 10 years.

Immunology, the study of the immune system, is an interdisciplinary field that draws from a number of biological and physical scientific fields, including biology, biochemistry, genetics, biochemistry, anatomy, physiology and microbiology, as well as physics, chemistry, mathematics, and engineering. Given its interconnectedness to several scientific disciplines, it is an excellent curricular choice for students interested in the health professions and students interested in careers in research, public health, and science policy.

Student learning outcomes:

- Demonstrate and apply an integrated knowledge of the immune system and its function, as it relates to host defense against a range of microbial pathogens or cancer, as well as the role of the immune system in causing diseases resulting from dysregulation of its normal function.
- Identify and discuss important issues related to immunology in community and global health.
- Describe the critical need to engage in effective science communication with the lay public.

- Engage with the infectious diseases and immunology healthcare and research communities to understand the importance of health-related professions and research in promoting health.

Requirements	Hours
BY 123 Introductory Biology I	4
MIC 150 Current Topics In Immunology	1
MIC 275 Introduction to the Immune System	3
MIC 325 Immunity to Emerging Infectious Disease	3
MIC 350 Immunology and Human Health	3
Immunology Elective	3
MIC 400 The Microbiome in Health and Immunity	
MIC 401 Foundations in Immunology: The Innate Immune System	
MIC 402 Foundations in Immunology: The Adaptive Immune System	
Total Hours	17

¹ At least 13 hours must be completed at UAB to graduate with this minor

Courses

MIC 150. Current Topics In Immunology. 1 Hour.

The goal of this seminar course is to present basic concepts in immunology as they relate to important current issues. The importance of the immune system in health and disease will be highlighted.

MIC 210. Special Topics in Immunology. 1-3 Hour.

This course covers introductory topics that are related to immunology and host defense.

Prerequisites: BY 123 [Min Grade: C] and BY 124 [Min Grade: C]

MIC 250. Seminars in Immunology. 1 Hour.

This seminar will feature a 30-minute introduction of a new basic concept in immunology followed by a 15-minute presentation from an individual faculty member who does research on that basic concept and a 15-minute discussion session.

MIC 275. Introduction to the Immune System. 3 Hours.

This course will provide a general overview of the immune system in protecting against microbial pathogens. The components of the immune system will be introduced, including the cells and tissues important for mediating immunity.

Prerequisites: BY 123 [Min Grade: C]

MIC 310. Special Topics in Immunology. 1-3 Hour.

This course covers topics related to immunology and host defense.

Prerequisites: BY 123 [Min Grade: C] and BY 124 [Min Grade: C] and MIC 275 [Min Grade: C]

MIC 325. Immunity to Emerging Infectious Disease. 3 Hours.

This course will: 1) discuss the cellular and molecular mechanisms employed by the immune system to provide protection against infectious microbial pathogens; 2) compare endemic versus emerging pathogens; 3) cover immunological principles important for detection of infectious organisms and infection; and 4) explain the development of vaccines, monoclonal antibodies, and anti-microbials, and their importance in providing protection against infectious diseases.

Prerequisites: MIC 275 [Min Grade: C]

MIC 350. Immunology and Human Health. 3 Hours.

This course will describe diseases that occur as a result of a breakdown in immune function (e.g. immunodeficiency) or loss of immune regulation (e.g. autoimmunity) and discuss how components of the immune system have been harnessed to generate diagnostics to detect disease and immunotherapeutics that can fight disease through targeted approaches.

Prerequisites: MIC 275 [Min Grade: C]

MIC 398. Undergraduate Research in Immunology & Host Defense. 0-6 Hours.

Research project under the supervision of a faculty sponsor. May be repeated for a total of 9 semester hours of credit. Students must have completed 12 semester hours of BY or MIC with a GPA of 3.0 and must receive permission of the instructor.

Prerequisites: PSDO 200 [Min Grade: C]

MIC 400. The Microbiome in Health and Immunity. 3 Hours.

This course will review the functions of the immune system and discuss the role of the microbiome in health and disease. This course will use a personal microbiome analysis project to develop information literacy, critical thinking, and communication skills while investigating the interplay between the microbiota and immune system components. Additional topics including the role of the microbiome in maintaining gut health, influencing the gut-brain axis, and nutrient synthesis will also be discussed.

Prerequisites: MIC 275 [Min Grade: C]

MIC 401. Foundations in Immunology: The Innate Immune System. 3 Hours.

This course will introduce the cells, receptors, signaling pathways and soluble mediators associated with the innate immune response. The basic components of the innate immune system will then be discussed in the context of their role in the physical, physiological, phagocytic and inflammatory barriers that comprise the innate immune system. Importantly, emphasis will be placed on the molecular and cellular mechanisms that are used by the innate immune system to detect and respond to microbial pathogens to provide the first line of defense.

Prerequisites: MIC 275 [Min Grade: C]

MIC 402. Foundations in Immunology: The Adaptive Immune System. 3 Hours.

This course will provide an in-depth analysis of the cells (T, B and antigen presenting cells), tissues (primary and secondary) and soluble factors (cytokines and chemokines) that comprise the adaptive humoral immune response. The course will examine how cells of the adaptive immune system discriminate self from non-self, including the nature of antigen receptors, the types of antigens recognized and the signals involved in the generation of effector cells that mediate the response.

Prerequisites: MIC 275 [Min Grade: C]

MIC 403. Foundations in Immunology: Microbial Pathogen-Immune System Interaction. 3 Hours.

This course will provide an overview of major concepts related to virulence mechanisms utilized by microbial pathogens and their effect on the host immune response. Emphasis will be placed on important virulence factors/mechanisms associated with bacterial, viral and fungal pathogens and how these alter various components of the innate and adaptive immune responses to allow escape of the pathogen and its survival. This course will introduce the concept of emerging infectious diseases and how their spread is related to their ability to escape detection by the immune system.

Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C]

MIC 404. Foundations in Immunology: Immunologically-Mediated Diseases. 3 Hours.

This course will focus on the role of the immune system, including the molecular and cellular processes, that contribute to morbidity and mortality associated with immunodeficiency (congenital and acquired), asthma/allergy, autoimmunity (systemic and organ-specific), transplantation and inflammatory syndromes associated with heart disease, cancer, chronic neurological disease and diabetes.

Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C]

MIC 410. Special Topics in Immunology. 1-3 Hour.

This course covers advanced topics related to immunology and host defense.

Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C]

MIC 450. Current Topics in Immunology. 1 Hour.

The goal of this seminar course is to present advanced concepts in immunology as they relate to important current issues. The importance of the immune system in health and disease will be highlighted.

Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C]

MIC 451. Seminar in Immunology Research. 1 Hour.

This seminar will feature a 30 minute introduction of a new advanced concept/technology in immunology followed by a 15 minute presentation from an individual faculty member who does research on that advanced concept/technology and a 15 minute discussion.

Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C]

MIC 490. Immunology Thesis. 0 Hours.

Students in the Undergraduate Immunology Program will submit documents and complete assessments required for graduation.

MIC 492. Undergraduate Research Seminar in Immunology and Host Defense. 3 Hours.

Elective course for non-Immunology Honors students who have completed at least one semester (3 credit hours) of MIC 398. Over the course of the semester, students will conduct research and learn how to develop and complete a paper or thesis on their research work while working closely with a supervising faculty member. In addition, the course will prepare them to present their research findings in a seminar format. Through these activities, students will develop effective skills in both written and oral scientific communication. Students will present a formal seminar on their research at the end of the course. Can be taken as a Capstone course (Immunology majors).

MIC 498. Honors Research in Immunology and Host Defense. 0-6 Hours.

Independent research under the supervision of a faculty mentor for students participating in the Immunology Honors Program. May be repeated for a total of 9 semester hour credits. Students must have completed 12 semester hours of BY or MIC with a GPA of 3.0 and must receive permission of the instructor.

Prerequisites: PSDO 200 [Min Grade: C]

MIC 499. Honors Research Seminar in Immunology and Host Defense. 3 Hours.

All Immunology Honors students are required to take this weekly course. Over the course of the semester, students will conduct research and learn how to develop and complete a paper or thesis on their research work while working closely with a supervising faculty member. In addition, the course will prepare them to present their research findings in a seminar format. Through these activities, students will develop effective skills in both written and oral scientific communication. Students will present a formal seminar on their research at the end of the course. This course can be taken the first semester following the completion of Honors Research in Immunology and Host Defense (MIC 498, minimum of 3 credit hours). Can be taken as a Capstone course (Immunology majors).