



**ALBANY COLLEGE OF PHARMACY
AND HEALTH SCIENCES**

Academic Program Review
Bachelor of Science in Microbiology
September 2018

School: School of Arts and Sciences

Department: Basic and Clinical Sciences

Dean & Chair: David Clarke, PhD

Program Director: Meenakshi Malik, PhD

TABLE OF CONTENTS

I.	Introduction	3
II.	Program History	5
III.	Program Mission, Goals and Objectives	6
IV.	Program Design	6
V.	Dual Degree BS Microbiology/MS Molecular Biosciences	10
VI.	Recruiting and Admissions	12
VII.	Student Profiles	13
VIII.	Faculty Profiles	15
IX.	Resources and Facilities	21
X.	Program Support	23
XI.	Program Capacity & Growth	24
XII.	Program Assessment & Outcomes	25
XIII.	Conclusions and Recommendations	31

I. INTRODUCTION

Microbiologists investigate the growth and characteristics of microscopic organisms such as bacteria, parasites or fungi. Biomedical Microbiology involves the study of bacteria (bacteriology) viruses (virology), and immunology (the study of mechanisms to fight infections). Medical microbiologists are needed to detect and study pathogenic microbes which cause disease in humans, pets, livestock, wildlife, and plants as well as develop vaccines and treatments for new, emerging and re-emerging diseases. Microbiologists will also be required to combat the threat of bioterrorism and the growing concern of antimicrobial resistant pathogens. More generally, well-trained microbiologists are also needed to maintain quality control standards for microbial contamination of drugs, food, medical devices, and water; and produce therapeutic and other commercially important proteins in recombinant microbes for the biotechnology industry. Due to these pressing societal needs, significant interest and demand will continue to exist for Microbiology majors.

Its specialized focus on biomedical sciences puts ACPHS in a strong position to offer an undergraduate degree program in Microbiology. The goal of the BS Microbiology (BSMB) program at Albany College of Pharmacy and Health Sciences is to prepare its graduates for employment or advanced study in fields requiring knowledge of microbial life, e.g., health care, public health, biotechnology, pharmaceutical sciences, medical equipment and supplies industry (Section III). Following completion of foundational courses, students can elect specific tracks which match their goals for each of these varied employment and educational opportunities in consultation with the faculty advisors within the department.

The program has three tracks that allow students to specialize in Biomedical Microbiology, Public Health Microbiology/Infectious Disease Epidemiology, or Industrial/Pharmaceutical Microbiology. The first two of these tracks are fully implemented. The College intends to begin offering the Industrial/Pharmaceutical Microbiology track in the 2019-2020 academic year. All three tracks in the program abide by the core curriculum guidelines of the American Society for Microbiology (ASM) for the baccalaureate degree program in microbiology. The following is a brief description of each of the three tracks of BSMB program along with the career objectives:

Biomedical Microbiology track educates graduates in understanding how infectious diseases occur. It serves as the foundation for advanced graduate studies in Microbiology, Immunology, Virology, and Cell & Molecular Biology. Graduates are prepared for entry into the professional schools such as medicine, veterinary, dental, and public health. Graduates also find jobs as research technicians in laboratories working in the area of microbiology and infectious diseases.

Public Health Microbiology/Infectious Disease Epidemiology track offers instruction on the public health impact of infectious diseases. It educates graduates in concepts, methods, and application of epidemiological principles related to infectious diseases. Graduates of the program have an in-depth understanding of the major laboratory and public health aspects of microbial pathogens. They gain epidemiologic skills relevant to the prevention and control of problems arising from infectious diseases. Graduates are prepared for careers in academic and industrial research laboratories, international health agencies, nongovernmental organizations and private consulting groups. In addition, they may work in federal, state and local public health agencies or state and local public

health laboratories where their technical expertise and population-based perspective is extremely useful.

Industrial/Pharmaceutical Microbiology track will prepare the students for the scientific principles, techniques and skills required in industrial microbiology. Specialized study will include biotechnology applications, biochemistry, analytical chemistry and pharmaceutical microbiology. This track will educate students in the areas of microbial contamination prevention, investigation, quality control and quality assurance, and aseptic processing. Students will gain experience in pharmaceutical processing and manufacturing and healthcare issues. Graduates will acquire skills required for quality control of raw materials and finished products, knowledge in drug and environmental regulations and guidelines along with learning the principles of Good Manufacturing Practices (GMP).

The BSMB program is a newer program offered by the Department of Basic and Clinical Sciences within the School of Arts and Sciences at ACPHS. Eleven students have graduated from the program in the last three years while 33 students are currently enrolled. The ultimate target number of students is 20 per year for a total of ~80 students in the program.

The curriculum of BSMB program was developed in accordance with the latest guidelines released by the ASM for Undergraduate Microbiology Majors in 2012, the same year this program was created (Section IV). Hands-on laboratory skills and research opportunities provide the foundation for the program. Students have the ability to be engaged in laboratory-based independent research projects beginning in their first year, working side-by-side with faculty whose expertise has attracted funding from various sources including the federal government. Student research experiences have spanned many types of projects that capitalize on faculty strengths in bacteriology, virology, immunology, and cell biology.

Since implementation in Fall of 2013, BSMB has undergone a few minor revisions to enhance the student experience, accommodate students' needs, better meet the program objectives, and to better foster development of scientific literacy and critical thinking skills (Section IV). The recently approved joint Bachelor's in Microbiology/Master's degree in Molecular Biosciences program (first class enrolled for Fall of 2018) has led to enhanced academic offerings and research opportunities, allowing students to earn both bachelor's and master's degrees in five years (Section V).

The program is adequately resourced in terms of faculty, laboratory space, and equipment. The core faculty in the program maintain active research programs, mentor undergraduate and graduate students, and seek to implement innovative pedagogies. Further information regarding faculty profiles, training, and demographics may be found in Section VIII. ACPHS currently has approximately 16,000 ft² of research and instructional laboratory space containing all the equipment required to carry out cutting-edge research in Biomedical Sciences. Further details of the facilities, resources and equipment can be found in Section IX.

Program students are supported primarily at the department level interacting regularly with the Program Director and Core Program Faculty. Additional support is provided by the Center for Student Success, which includes a variety of academic support, advising, and career services. Details of this, and other student support functions on campus, can be found in Section X.

The program places strong emphasis on post-graduate career outcomes. Almost all of the BSMB graduates have gone on to graduate or professional schools or post-baccalaureate careers in healthcare or biopharmaceutical industry. Section XII include details of the assessment of Program and Student Learning Outcomes.

II. PROGRAM HISTORY

A. Program Context

Albany College of Pharmacy and Health Sciences (founded 1881) is New York State’s oldest pharmacy school. It is a private, not-for-profit educational institution with a 30-acre, eight-building main campus in Albany, NY, satellite campus in Colchester, VT, and the Pharmaceutical Research Institute (PRI) building in Rensselaer, NY, with a total of 1,400 students enrolled in all programs. The College offers a Doctor of Pharmacy (Pharm.D.) and four-year Bachelor of Science degrees in Microbiology, Pharmaceutical Sciences, Public Health, Biomedical Technology, and Clinical Laboratory Sciences. ACPHS also offers Master’s of Science degrees in Molecular Biosciences, Pharmaceutical Sciences, Cytotechnology and Molecular Cytology, Health Outcomes Research, and Clinical Laboratory Sciences.

The BSMB program at ACPHS is particularly geared towards medical, pharmaceutical and public health microbiology. A combination of basic science, with clinical and translational research, provides ACPHS a unique niche not found in many other institutions. There are very few institutions in the entire Northeast that offer a BS in Microbiology degree and none are in the Capital region. The only institution in New York State that currently offers a BS in Microbiology degree is Wagner College which is a liberal arts college and does not have a strong focus on Medical Microbiology.

The program was developed after performing a significant needs analysis on job outlook, salaries and other programs offering the major, nationally and regionally, for the decade of 2010-2020. The findings of the analysis performed in 2012 are provided in Appendix A. According to the United States Department of Labor, the total employment of microbiologists in the next decade (2016-2026) is projected to grow at 8% over the 2010-2020 decade, about as fast as the average of all occupations. With the current and projected need for microbiologists in basic research and the biopharmaceutical industry, and an average median pay of \$69,960 annually (2017 data), we expect that significant interest and demand will continue to exist for Microbiology majors.

B. Implementation Timeline

May 2012	New York State Approval (HEGIS Code 0411)
July 2012	Recruitment began for first and second year students
August 2013	First class enrolled
May 2016	First class graduated (4 students)
May 2017	Second class graduated (4 students)
May 2018	Third class graduated (3 students)

III. PROGRAM MISSION, GOALS & OBJECTIVES

A. Mission

To provide outstanding education and training to undergraduate students in the theoretical knowledge and laboratory skills of microbiology relevant to human health.

B. Goals

The goal of the BSMB program at Albany College of Pharmacy and Health Sciences is to prepare its graduates for employment or advanced study in fields requiring knowledge of microbial life, e.g., health care, public health, biotechnology, pharmaceutical industry, academic and government sectors.

C. Objectives

All graduates of the program are expected to fully integrate the theoretical knowledge and laboratory skills of microbiology along with developing scientific reasoning, critical thinking, and communication skills. They are expected to:

1. demonstrate a working knowledge of traditional and emerging areas of microbiology
2. obtain, interpret, and apply information about microbiology from the scientific literature
3. integrate and apply knowledge to solve complex scientific problems.
4. formulate hypotheses to explain research problems and demonstrate an understanding of the facilities and expertise necessary for testing these hypotheses
5. possess appropriate laboratory skills including the ability to observe and record results, work safely, self-organize and manage one's time.
6. effectively communicate scientific information both orally and in writing
7. work both independently and collaboratively in scientific processes
8. understand their ethical and professional responsibilities and be aware of the contemporary societal and global issues facing scientists.

IV. PROGRAM DESIGN

Our Bachelor's in Microbiology (BSMB) program has been designed according to the guidelines published by ASM for Undergraduate Majors (Appendix B) to include both the coursework and hands-on laboratory and research experiences required to succeed in this dynamic field. The result is a degree that serves as a springboard to Master's or PhD-level programs, medical school, or entry-level positions in academic and government laboratories, or the biopharmaceutical industries.

Degree requirements for the BSMB program include completion of both required and elective coursework. Depending on the student's track, the number of total credits needed for completion of the degree is 122-124 credits. All students in the program are required to complete 39 credits of Basic Science courses, 14 credits of Humanities and Communication courses, 33 credits of Microbiology core courses, 14-16 credits of track specific courses, and 21 credits of free electives. Specifics of the BSMB Curriculum are detailed below. Sample schedules for the last five years can be found both in the ACPHS College Catalog and Appendix C.

A. Curriculum

All students, regardless of track selected, complete the following core curriculum. Students will be required to complete one of the tracks described below. Each track contains 9-11 credits of required courses. Students must also choose 5-6 credits from a list of approved track electives.

CORE CURRICULUM

BASIC SCIENCES: 39 REQUIRED CREDITS

- BIO 101 and 102: General Biology I and II (4, 4)
- CHE 101 and CHE 102: General Chemistry I and II (4, 4)
- CHE 211 and 221: Organic Chemistry I and II (4, 4)
- PHY 212 and 222: College Physics I and II (4, 4)
- MAT 121: Calculus I (4)
- MAT 145: Elementary Statistics (3)

HUMANITIES AND COMMUNICATIONS: 14 REQUIRED CREDITS

- HUM 101, 102 and 201: Pre-Modern World (3), Modern World (3), Contemporary World (3)
- COM 115: Principles of Communication (3)
- BIO 253: Scientific Communications (2) [or other comparable course]

MICROBIOLOGY: 33 REQUIRED CREDITS

- BIO 210: Microbiology (4)
- PSC 315: Immunology (3)
- PSC 311: Biochemistry (3)
- BIO 235: Cell Biology (3)
- BIO 340: Microbial Genetics (3)
- BIO 370: Microbial Physiology (3)
- BIO 350 and 355: Biomedical Laboratory Techniques I and II (3, 3)
- BIO 660G: Microbiology Journal Club (1+1) – course is taken twice
- BIO 480 and BIO 485: Microbiology Capstone Experience I and II (3, 3)

Options for Microbiology Capstone Experience - Research (a minimum of 3 credits), Internships, and/or Independent Projects. The plan for the Capstone Experience should be developed by the student in conjunction with the faculty adviser and Program Director and approved in spring of the Junior Year.

ELECTIVES: 21 CREDITS

At least 9 credits must be in the humanities or social sciences.

TRACK CURRICULUM

BIOMEDICAL MICROBIOLOGY TRACK

- BIO 680G: Bacterial Pathogenesis (3)
- BIO 240: Virology (3)
- BIO 365: Medical Mycology and Parasitology (3)

A minimum of 5 credits chosen from BIO 225: Genetics (3), BIO 213: Anatomy & Physiology I (3), BIO 215: Anatomy & Physiology II (3), ETH 310: Bioethics (3), BIO 240: Virology (3), BIO 365: Medical Mycology and Parasitology (3), PSC 321: Physiology/Pathophysiology I (3), PSC 322 Physiology/Pathophysiology II (3), BIO 625G: Advanced Molecular Biology (3), BIO 630G: Advanced Cell Biology (3), BHS 745G: Molecular Diagnostics (3), BIO 620G: Advanced Topics in Microbiology (3). Other courses may be counted at the discretion of the Program Director.

PUBLIC HEALTH/INFECTIOUS DISEASE EPIDEMIOLOGY TRACK

PAD 393: Introduction to Epidemiology (3)
BIO 315: Public Health Microbiology (3)
PBH 330: Global Perspectives in Epidemiology (3)

A minimum of 5 credits chosen from SOC 120: Introduction to Public Health (3), PSC 432: Infectious Disease Pharmacology (3), ETH 310: Bioethics (3), HRI 600G: Issues in Global Health (3), PHM 350: Applied Methods in Epidemiological Research (3), BIO 270: Public Health Toxicology (3), PBH 360: Field Epidemiology (3), HRI 646G: Epidemiology II (3). Other courses may be counted at the discretion of the Program Director.

INDUSTRIAL/PHARMACEUTICAL MICROBIOLOGY TRACK

BIO 360: Industrial Microbiology and Bioprocessing (3)
BIO260: Public Health Toxicology
BIO 410: Pharmaceutical Microbiology (3)

A minimum of 5 credits chosen from PSC 341: Pharmaceutics I (3), PSC 342: Pharmaceutics II (3), CHE 375: Analytical Chemistry I (4), CHE 380: Analytical Chemistry II (4), BIO 455: Toxicology (3), SOC 335: Public and Health Policy (3). Other courses may be counted at the discretion of the Program Director.

TOTAL CREDITS: 122-124 CREDITS

B. Curriculum Mapping to Program Objectives

Goals and Objectives for the BSMB program (as described in Section III) may be broken down into both the General Education/General Abilities Objectives and the BSMB-specific Program Objectives.

The General Education program at ACPHS supports the mission of the College to instill values, attitudes and skills that enable lifelong intellectual, cultural, personal and professional growth. The General Ability Based Outcomes are primarily met during the student's first two years in the program (details provided in Appendix D). These include the basic sciences, humanities, liberal arts, and communications courses and are housed within various departments in the School of Arts and Sciences. These courses expand the student's historical, cultural, literary, scientific and philosophical perspectives. They also foster the critical assessment of ethical and humanistic values, and emphasize the communication, critical thinking and problem-solving skills that prepare the student to advance in their professional discipline and cultural competency. Through its blend of required and elective

courses, the College strives to expose students to the complexities of the world and prepare them to become valuable participants. The School of Arts and Sciences is currently in the midst of mapping the General Education courses offered in the first two years to the General Ability Based Outcomes as detailed in Appendix D. The results of this exercise are expected by Fall 2018.

The BSMB program at ACPHS has specific programmatic objectives (Section III) which foster theoretical and lab-based scientific skills, critical thinking, and communication skills in order to help students achieve their career goals. Courses are aligned and sequenced in a manner to build upon a student's knowledge and continually introduce developing topics in Microbiology. As the Microbiology field relies on basic science premises, the first two years of the curriculum are heavily weighted with math and science courses (e.g. Calculus, Chemistry, and Biology) which build the groundwork for future student development in various specialties within Microbiology (e.g. Biomedical Microbiology or Public Health Microbiology/Infectious Disease Epidemiology). The overall Programmatic Objectives have been mapped to the courses in the curriculum and are presented in Appendix E.

There are currently no national accreditation standards for benchmarking the BS Microbiology program. However, in an effort to provide guidance in the education of undergraduate students in microbiology, the American Society for Microbiology (ASM) has developed a set of curriculum guidelines for microbiology majors (Appendix B). According to ASM, the guidelines are not meant to be a set of criteria for accreditation of a program. Rather they are meant to be used by programs in their own assessment, maintenance, and formation of strong programs in microbiology. Appendix F provides a summary of courses offered in BS Microbiology program at ACPHS in comparison to ASM curriculum recommendations for undergraduate majors. The ASM task force also updated the Curriculum Guidelines for Undergraduate Microbiology Education in 2012 and identified key concepts and skills that are (i) central to microbiology and (ii) useful to define curriculum learning goals for general microbiology. These key concepts and skills identified by the Task Force have been mapped to the topics covered in core courses of the curriculum (Appendix F). With the exception of Microbial Ecology and Diversity, the BSMB curriculum is meeting all the ASM recommendations. Although some topics are discussed in General Biology and Microbiology courses, a course in this area would strengthen the curriculum.

Almost all of the required courses in the Program are taught by the core Microbiology faculty members. However, some track-specific courses are offered by other departments at the College. Department of Population Health Sciences (DPH) housed within the School of Arts and Sciences offers a BS in Public Health Program. DPH offers several courses in Public Health including Introduction to Public Health and Global Perspectives in Epidemiology that students in the BSMB program take advantage of. A few other courses including Epidemiology I and Applied Methods in Epidemiological Principles are offered by the Department of Pharmacy Practice within the School of Pharmacy and Pharmaceutical Sciences. These offerings satisfy core and elective requirements of the Public Health Microbiology/Infectious Disease Epidemiology Track within the BSMB program.

C. Curriculum Revisions

There have been some minor curriculum revisions undertaken since the creation of BSMB program in 2013 (Appendix G).

1. A free elective was added to the curriculum to replace previous courses (Seminar in Health Professions, Introduction to Laboratory Data) with a credit-to-credit swap. This brought the total number of free electives requirement to 21 credits.
2. A two semester Journal Club was added as a required co-requisite course for all Senior Year students enrolled in Microbiology Capstone Experience I and II courses to further improve their scientific thinking and communication skills.
3. The next revision was made after several elective courses offered by the DPH were discontinued. This necessitated new elective offerings by DPH and BCS, some of which were taught by new faculty hired recently in both the departments. Some of these additional courses included Introduction to Public Health, Public Health Microbiology, Global Perspectives in Epidemiology, and Public Health Toxicology.
4. To eliminate content redundancies in the current curriculum, a revision was made last year to eliminate the Molecular Biology course and replace it with a new course Medical Mycology and Parasitology (for Biomedical Track) or Cell Biology course (for the other two tracks). The reason for this change was that Molecular Biology which covers both prokaryotic and eukaryotic genetics overlapped significantly with Microbial Genetics especially, in the topics related to prokaryotic molecular biology. Furthermore, Cell Biology (a required course for Biomedical track) covered the remaining topics (eukaryotic biology) that were taught in Molecular Biology.
5. Since the creation and approval of a joint degree program in BS Microbiology and MS Molecular Biosciences last year (details provided in Section V), we have added several graduate level courses that could be taken by BSMB Senior Year students who are also First Year graduate students. Some of these courses that can serve as Required Track courses include Advanced Molecular Biology, Advanced Cell Biology and Advanced Topics in Microbiology.

These curriculum revisions were done to enhance the student experience, fit the student's needs, better meet the program objectives, and to foster development of scientific literacy and critical thinking skills in order to better prepare the student to perform a hypothesis-based research project as a capstone to their BSMB degree.

V. DUAL DEGREE: BS MICROBIOLOGY/ MS MOLECULAR BIOSCIENCES

The dual BS/MS degree program provides students enrolled in the Bachelor of Science program in Microbiology the opportunity to concurrently pursue the Master of Science degree in Molecular Biosciences, beginning in the fourth year of their undergraduate program, and complete both degrees in five years. This dual degree program reduces the total number of courses needed and the total time required for completion of both the BS and MS degrees. As with other combined degree programs at ACPHS, both the BS and the MS degrees are awarded upon completion of the MS degree. Students enrolled in the BSMB program apply to the School of Graduate Studies in their third (junior) year according to established procedures and deadlines of the School of Graduate Studies. Students are expected to have a cumulative GPA of 3.0/4.0 at the time of application. The GRE is not required for applicants with cumulative GPAs of 3.0 or higher. In order to complete the dual degree program in five years, students are expected to utilize two summers (between 3rd and 4th year and between 4th and 5th year) to complete their master's thesis research project.

The dual BS, Microbiology/MS, Molecular Biosciences degree program has a total of 146 credits, 113 undergraduate credits and 33 graduate credits, with 9 graduate credits that are counted toward both degrees. Students completing this program are trained as scientists in the basic mechanisms of human health and disease, with emphasis on infectious disease. The program is interdisciplinary, bringing together basic, applied, and clinical scientists from a number of departments to provide students with individualized, cutting-edge biomedical research training and foundational coursework. The BS courses in the program are designed to provide students with a strong didactic foundation in the biomedical sciences, with emphasis on microbiology and infectious diseases, and couples this foundation with early exposure to biomedical research. This allows the students to progress into the advanced courses and research experiences in the MS, Molecular Biosciences program on an accelerated timeline. Students are expected to choose a BS capstone topic in consultation with MS Molecular Biosciences faculty so that the capstone research can be expanded to a Master's thesis. It is expected that Research Rotation (BIO670G- Graduate) and Capstone Experience (BIO480/485- Undergraduate) in the Fourth year of Undergraduate/First Year of Graduate study run concurrently under one Faculty mentor (5 credits of total time- 3 credits for Capstone and 2 credits of Research Rotation). Research areas encompass a broad range of disciplines including molecular genetics, cell biology, biochemistry, pathophysiology, microbiology, immunology, and infectious diseases. Research is further supported with courses in the core biomedical disciplines, laboratory research techniques, ethical conduct of science, and a graduate seminar course. A major requirement for program is the completion of original research and the publication of a thesis describing that research. The program emphasizes the importance of high quality research, and is designed to assist students in fulfilling their potential as research scientists. This dual degree program provides graduates with a competitive advantage in applying to PhD programs, professional schools of medicine and dentistry as well as positions in biotechnology and pharmaceutical companies. Given below is the Program of Study for students enrolled in the dual degree. A sample schedule is provided in Appendix H. The enrollment in this dual degree program will start in Fall 2018.

Dual Degree (BS Microbiology/MS Molecular Biosciences) Curriculum (2018-2019)

CODE	COURSE NAME	CREDITS
BIO 101	General Biology I	4
CHE 101	CHE 101: General Chemistry I	4
HUM 101	HUM 101: Pre-Modern World	3
MAT 121	Calculus I	4
BIO 102	General Biology II	4
CHE 102	General Chemistry II	4
HUM 102	Modern World	3
COM 115	Principles of Communication	3
CHE 201	Organic Chemistry I	4
PHY 212	College Physics I	4
BIO 210	Microbiology	4
HUM 201	Contemporary World	3
CHE 253	Scientific Communications	2
CHE 202	Organic Chemistry II	4
PHY 222	College Physics II	4
MAT 145	Elementary Statistics	3

BIO 240	Virology	3
PSC 315	Immunology	3
PSC 311	Biochemistry	3
BIO 370	Microbial Physiology	3
BIO 350	Biomedical Lab Techniques I	3
BIO 365	Medical Mycology & Parasitology	3
BIO 340	Microbial Genetics	3
BIO 355	Biomedical Lab Techniques II	3
BIO 325	Cell Biology	3
BIO 480	Microbiology Capstone Experience I	3
MAT	Statistical Inference and Modeling	3
BIO 625G	Advanced Molecular Biology	3
BIO 670G	Research Rotation	2
---	UG Electives	21
BIO 660G	Molecular Biosciences Journal Club	3
BIO 485	Microbiology Capstone Experience II	3
BIO 650	Research Design	2
BIO 630G	Advanced Cell Biology	3
BIO 645G	Bacterial Pathogenesis	3
ETH	Ethics in Research	1
---	Graduate Electives	9
BIO 701G	BIO701G: Thesis Research	6
TOTAL (UNDERGRADUATE)		113
TOTAL (GRADUATE)		33
TOTAL		146

VI. RECRUITING & ADMISSIONS

The Office of Admissions within the Enrollment Management Department recruits students (first-time freshman and transfer students to the first, second, and third year entry points) to the Bachelor of Science in Microbiology in accordance with the College Academic Admissions Policies (Appendix I). In consultation with the department and Program Director, the Admissions Office develops an annual recruitment plan that includes lead acquisitions from higher education vendors such as the College Board, digital/print marketing collateral, visits to high schools/community colleges, and on-campus visit programming. Program faculty communicate with prospective students during campus visits, have laboratory demonstrations with Q&A sessions about the program in-person and via phone/email outreach.

Enrollment numbers in the BSMB program since inception are given in the table on the following page. A total of 33 students are enrolled in the program currently. The ultimate target number of students is 20 per year for a total of ~80 students in the program. The detailed enrollment numbers in required and elective courses for the last five years is provided in Appendix J.

Numbers of Enrolled Students in the Program

Academic Year	Number of Enrolled Students			
	First Year	Second Year	Third Year	Fourth Year
Fall 2013	8	1	0	0
Fall 2014	3	5	5	0
Fall 2015	5	3	5	4
Fall 2016	6	5	2	4
Fall 2017	11	6	4	3
Fall 2018	15	9	5	4

Most of the recruiting strategies used for the BSMB program are consistent with recruitment strategies for all the undergraduate programs at the college and are distinct from recruitment tools used for the Pre-Pharmacy and the PharmD professional program. Since BSMB program has been relatively new, the challenge in recruitment has been to spread the word about the program and its quality, especially in the northeast. The Program Director and the Core Faculty are working closely with Enrollment Management to devise strategies specific for recruitment to the BSMB program. Some of these strategies to be used in future include inviting high school students for laboratory demonstrations, tours of research labs, faculty presentations in local schools, and providing summer research opportunities to high school students.

VII. STUDENT PROFILES

A. Demographic Profiles

Student profiles are compiled by the Office of Enrollment Management. The Program has generally attracted students of demographic that are typical of a traditional college student. In Fall 2017, of a total of 24 students in the program, 66.6% were 18-19 years of age while 20.8% were 20-21 years old. In the same cohort, male and female students were 50% each. In terms of race/ethnicity, 66.6% students were Caucasian, 8.3% Asians, 8.3% Hispanics and 4.1% international students. The table shown in Appendix K provides the details of demographic profile of current students in the program. Efforts are currently underway to recruit a diverse group of students by actively marketing the program in the rural and urban environments of nine different states including Puerto Rico. This strategy has resulted in increased applications from these areas.

B. Retention Rate

In the last five years (2013-2018), the BSMB program has an average retention rate of 72.75%. Some students decided to transfer out of the institution due to personal reasons, while some others pursued careers in other healthcare professions, including PharmD, BS degrees in Public Health or Clinical Laboratory Science at ACPHS. Transferring to internal programs increased the overall student retention at ACPHS. A small percentage of students leave the institution due to academic dismissals.

Graduation times for all students in the program has been four years. Details of retention rates by year and graduation times are given below.

Retention Rate by year and academic status

Beginning Term	Retained Term	Retention Rate	Notes
Fall 2013	Fall 2014	67%	9 possible returners. 6 students returned to BSMB program. 2 students left ACPHS and transferred to another institution. 1 student withdrew from ACPHS.
Fall 2014	Fall 2015	85%	13 possible returners. 11 students returned to BSMB program. 1 student switched major to BS Clinical Lab Sciences. 1 student was dismissed from ACPHS.
Fall 2015	Fall 2016	77%	13 possible returners. 10 students returned to BSMB program. 2 students withdrew from ACPHS. 1 student switched major to BS Biomedical Tech.
Fall 2016	Fall 2017	62%	13 possible returners. 8 students returned to BSMB program. 2 students withdrew from ACPHS. 1 student switched major to BS Health and Human Sci/PA. 1 student switched major to Pharm D. 1 student was dismissed from ACPHS.

Time to graduation by year

Year of Graduation	Number of Graduates	Average Time to Graduation (years)
2015- 2016	4	4
2016 - 2017	4	4
2017 - 2018	3	4

Data suggests that retention rates in the first two years of the program are lower than the other years. This is due to a number of reasons including the difficult transition from high school to college environment and challenging introductory science courses like Calculus, General Chemistry, Organic Chemistry and Physics. Third and fourth year retention rates are almost 100% and result in successful graduation outcomes. Due to this trend, strategies to further explore opportunities to recruit transfer students in third and fourth years will be important.

C. Program Specific Efforts to Improve Retention

The College utilizes an Early-Intervention system to identify students “at risk” in various stages during their curriculum and provides outreach and other support services (See Appendix O). Several other measures including efforts to ensure comparable learning across multiple sections, offering required and elective courses at appropriate schedule, internship opportunities and student advising to enhance student experience in the Program are outlined in Appendix P. However, due to the rigorous science focused curriculum, some students find the large lecture courses in Calculus, General Chemistry,

Organic Chemistry, and Physics very challenging. To overcome this challenge, the Department of Basic and Clinical Sciences offers separate courses of Calculus and General Chemistry for all BS students. This results in smaller class sizes and enhanced student experience. Starting from Academic Year 2018-19, all Freshman BS students will be sent preparatory material for General Biology and General Chemistry courses in the summer prior to joining ACPHS to make them better prepared for College level material. Additionally, the Department will be offering a Pre-calculus course in the summer prior to the students joining the College which can be used to build necessary math skills. Yet another strategy proposed to improve academic performance of at-risk students and reduce their academic burden will be implemented in the Year 2018-19. The schedules for first year students will be modified such that they will be taking only two science courses (General Biology I & General Chemistry I) in their first semester. The expectation is that once the students adjust to the environment and gain experience in taking college-level coursework in their first semester, they will be better prepared to handle more intense science courses in future semesters. Additionally, the Department is planning to offer certain course sequences like Organic Chemistry I & II in both semesters to ease remediation of these challenging courses. Academic Standards & Course Remediation Policies are detailed in Appendix I.

If students are unable to handle the coursework in the Program after extensive advising and use of student support services like Science Assistance Center and Peer Mentoring (Appendix O), they are informed about some of the other programs at the College that are more suited to their academic abilities. This strategy has improved the retention rate of the College and has led to successful graduation outcomes for the students.

VIII. FACULTY PROFILES

The BSMB Program is supported by eight Microbiology faculty members including the Program Director. The Program Director oversees the operations of the program including areas of curriculum development, student advising, retention, capstone coordination, and resource management. The detailed responsibilities of the Program Director are given in Appendix L. The disciplines, qualifications and courses taught by the program faculty are given below.

Faculty Member Name & Title	Degrees & Disciplines	Additional Qualifications	Courses taught in the BSMB Program	Years of Service
Core Microbiology Faculty				
Meenakshi Malik Associate Professor with Tenure & Program Director	DVM, PhD, Immunology Indian Veterinary Research Institute, India	Post-doctoral fellowship in Microbial Pathogenesis at Albany Medical College; Has 20 years of research experience in bacterial pathogenesis. Has over 40 publications and maintains an NIH funded research program; prior employment includes a faculty appointment at Albany Medical College.	Microbiology, Microbiology Capstone Experience I & II, Bacterial Pathogenesis	8

Eric Yager Associate Professor, Non-tenure Track	PhD, Biomedical Sciences, State University of New York at Albany	Postdoctoral fellowship at Trudeau Institute, NY and Albany Medical College spanning the areas of immune response, vaccine development, and host-virus interactions. Has over 20 publications in the area of microbial immunology.	Microbiology Lab, Virology, Biomedical Lab Techniques I & II, Microbiology Capstone Experience I & II	7
Michelle Parent Associate Professor with Tenure	PhD, Microbiology/Immunology, University of Massachusetts, Amherst, MA	Postdoctoral fellowship at University of Massachusetts, Amherst and Trudeau Institute, NY in Immunology. Is board certified by the American Society for Clinical Pathology as a Medical Technologist. Prior faculty appointments include tenured Associate Professor and Interim Chair at University of Delaware, Newark, DE. Has over 30 publications and has received research funding from government and private industry.	Microbiology Capstone Experience I & II	1
Binshan Shi Associate Professor with Tenure	PhD, Cancer Biology, Zhejiang University, China	Prior appointments include Senior Bacteriologist and Research Scientist II position at Wadsworth Center, NY State Dept. of Health, Albany NY. Research interests are mainly focused on understanding the molecular basis of disease pathogenesis by using advanced molecular biology, virology, molecular genetics, and bioinformatics approaches. Has published 18 papers in the area of Cancer Biology and HIV pathogenesis.	Microbiology Capstone Experience I & II	7
Tim LaRocca Assistant Professor, Tenure track	PhD, Molecular Genetics and Microbiology, Stony Brook University	Post-doctoral fellowship in Stony Brook University and Columbia University in membrane biochemistry and mechanisms of cell death. Has published 15 papers in microbiology and cell biology and maintains an NIH funded research program (R15) at the College.	Microbial Physiology, Advanced Molecular Biology, Advanced Cell Biology, Microbiology Capstone Experience I & II	3.5

John Sharifi Assistant Professor Non-tenure Track	PhD in Immunology & Microbial Disease, Albany Medical College, NY	Post-doctoral Fellowship at Albany Medical College in the area of HIV pathogenesis. Is a co-investigator on NIH R21 grant with Albany Medical College	Microbiology Labs, Cell Biology, Medical Mycology and Parasitology, Microbial Genetics, Journal Club	2
Nicole Shakerley Assistant Professor Non-tenure Track	PhD, Nanoscale Science, College of Nanoscale Science and Engineering, State University of New York	Post-doctoral Fellowship at Albany College of Pharmacy & Health Sciences in the area of Programmed Cell Death. Is board certified by the American Society for Clinical Pathology as a Molecular Biologist. Has 10 years of experience in redox biology and bacterial pathogenesis and is a collaborator on an R01 grant with SUNY Polytechnic Institute, NY	Public Health Microbiology, Microbiology Capstone Experience I & II, Journal Club, Research Design	1
Ebot Tabe Instructor	PhD, Molecular Pathogenesis, North Dakota State University, ND	Post-doctoral Fellowship in NIH Biodefense and Emerging Infectious Disease, NY State Dept. of Health, Albany NY. Has 15 years of experience in clinical lab and biomedical sciences with a focus on studying host-pathogen interactions.	Microbiology Capstone Experience I & II	3
Faculty Members in other departments offering courses in the Program				
Wendy Parker Associate Professor	PhD in Sociology, Maxwell School of Citizenship and Public Affairs at Syracuse University, NY	Dr. Parker is a medical sociologist and interdisciplinary health services researcher. Her research experience crosses both qualitative and quantitative methodologies. Dr. Parker studies health disparities throughout the life course in vulnerable populations with a specific emphasis on maternal and child health.	Introduction to Public Health	8
Thomas Lodise Professor	Pharm.D., Temple University School of Pharmacy PhD in Epidemiology, University of Albany SUNY	Registered Pharmacist. Dr. Lodise's research program focuses on the epidemiology and outcomes of bacterial infections. His work also explores the antibiotic exposure-response relationship among patients with the intent of improving patient outcomes and reducing emergence of antibiotic resistance. Has published more than 100 peer-reviewed articles and has secured over \$1.5 million in grant funding.	Epidemiology I	16

Joseph Carreno Assistant Professor	PharmD, Albany College of Pharmacy and Health Sciences	Registered Pharmacist. Completed Infectious Diseases Pharmacy Fellowship at Wayne State University. Research interests include the application of technology and epidemiologic methods to evaluate and develop antimicrobial stewardship programs.	Applied Methods in Epidemiological Principles, Microbiology Capstone I & II	5
Mehdi Rajabi, Research Scientist, Pharmaceutical Research Institute	PhD, Molecular Medicine, Milan State University, Milan, Italy	As a bioconjugate chemist, Dr. Rajabi studies the chemical modification of different small bioactive molecules for conjugation to nanoparticles for cancer delivery applications. Other interests include the development of novel nanostructures for application in nanomedicine.	Biochemistry	4

Core Faculty Demographics

Rank		Gender		Race/Ethnicity	
Instructor	1	Male	5	White	5
Assistant Professor	3	Female	3	Black	1
Associate Professor	4			Asian	2
Professor	0				

A. Faculty Responsibilities to the Program and Other Activities

All core faculty members teach courses required for the Program and also offer additional elective courses in their field of expertise that is often aligned with their research area. Additionally, faculty members teach in other programs offered by the department including Pre-Pharmacy, Clinical Laboratory Science, and Graduate Programs. Appendix M defines individual faculty teaching activities including courses directed/taught for the program, other departmental/faculty course commitments outside the BSMB programs. Faculty members in the program are also engaged in scholarly activities that includes grants, publications, presentations, and student engagement in research projects. Two of the four tenured/tenure track microbiology faculty members have extramurally funded research programs. The non-tenure track faculty members in the program also mentor student research projects including independent study and capstone experiences. Two of these faculty members have extramural support through collaborations with outside institutions. Details of faculty scholarship are provided in Appendix M.

Additionally, faculty in the program make concerted efforts to take on service activities that are aligned to their teaching and research goals. They are actively engaged in service to the department and college including serving on the Biosafety Committee (BSC), Institutional Review Board (IRB), Institutional Animal Care and Use Committee (IACUC), the Faculty Senate, College Curriculum Committee

(CCC), College Admissions Committee (CAC) and College Academic Standards Committee (CASC). Furthermore, the program faculty are engaged in service activities that extend beyond ACPHS; where they are active members of the scientific community and the society at large. Some of the activities program faculty are routinely involved in include serving on NIH Study Sections, reviewing manuscripts for microbiology and infectious diseases journals, organizing the Annual Conference of Eastern New York branch of ASM, and organizing the Annual Student Research Symposium at ACPHS. Detailed service activities (both intra- and extramural) as well as honors and achievements of faculty members supporting the Program are detailed in their CVs provided as a separate document.

B. Faculty Workload Data

The BSMB program has undergone appreciable growth since its inception and continues to do so. The department has increased the number of microbiology faculty members from 3 to 8 since 2014. This has resulted in an expansion of course offerings and better research opportunities to students. The hiring of two additional faculty members (1.5 FTE) will allow the Program to offer its Industrial/Pharmaceutical Microbiology track. The table below provides a summary of the workload as percent efforts in the three evaluation categories: research/scholarship, service, and teaching.

Workload as percent effort for BCS faculty (2017-18)

Faculty Member	Percent Effort		
	Teaching	Research	Service
Malik, Meenakshi	30	60	10
Parent, Michelle	40	45	15
Shi, Binshan	45	45	10
LaRocca, Tim	45	45	10
Yager, Eric*	70	20	10
Sharifi, John*	70	20	10
Shakerley, Nicole*	70	20	10
Tabe, Ebot#	80	10	10

*Indicates a non-tenure track faculty appointment

Instructor

These percentages were derived from the 2018 annual review of each faculty. All tenure-track faculty provide approximately 30-45% effort in teaching and are able to meet the expected 45-60% effort in research. The four non-tenure track faculty listed are closer to the expectations (70% teaching, 20% scholarly activity and 10% service) for each category. Generally, tenure track faculty meeting the 40-45% teaching effort would teach the equivalent (on average) of 1-2 courses per semester, which typically would be 3 credit courses. Non-tenure track faculty have a teaching load of at least double, or the equivalent of two, three-credit courses per semester.

An ongoing faculty recruitment plan involves recruiting two new faculty members in 2019. The candidates for a tenure-track position will have a strong research program in complementary areas of research existing in the microbiology program and will be responsible for teaching Immunology to BSMB and PharmD students. A second hire will be a non-tenure-track position to be shared between

Basic and Clinical Sciences and Pharmaceutical Sciences departments. The primary responsibility of this position will be to kick-start the Industrial/ Pharmaceutical track of BSMB.

C. Faculty Professional Development

The small size of ACPHS faculty contributes to the highly interactive environment in which the faculty readily collaborate across departmental boundaries, yet is conducive to modern basic research at a highly competitive level. The College is home to faculty members in wide ranging areas including specialties in microbiology, immunology and infectious diseases, developmental biology, biochemistry, pharmacology, medicinal chemistry, and nephrology. The integrated nature of the academic programs and the research activity, coupled with well-trained students, a collaborative atmosphere among faculty and broad institutional support for research, creates an environment at ACPHS that is highly conducive to developing creative scientific ideas and engaging in meritorious research.

The BSMB program has a focus on Biomedical Microbiology and all core faculty members specialize in understanding the molecular basis of infectious disease pathogenesis. Some of the research areas include immunity to bacterial pathogens, mechanisms of antibiotic resistance, HIV pathogenesis, and mechanisms of cell death. Faculty members contribute to the breadth and depth of the BSMB program through course offerings and individual research projects.

Teaching

The College has invested in new teaching modalities through the Center for Innovative Learning that offers faculty direct support for various active learning techniques, such as flipped classrooms and team-based learning. Each faculty is introduced to the Center upon orientation and encouraged to employ innovative teaching methods. Since the class sizes for the BSMB students are typically 15 students or less, case-based instruction and flipped classrooms are popular. Course proposals (attached as a separate appendix) detail the methods of instruction and learning outcomes assessment. Teaching is assessed by students through course and instructor evaluations at the end of each course, which are available to both the instructors and Chairs. Evaluations include both numbered rankings and extemporaneous comments. When student evaluations depict course content problems, the Chair will meet with the instructor to discuss means to improve. Some other issues may require input from the Center for Innovative Learning and continued monitoring provided by the Chair and peers. Although student evaluations are not solely for the purpose of ensuring the quality of the course content it is a valuable tool. Peer-review of teaching occurs annually by either formal scheduled or ad-hoc “site visits” to the instructor’s class. Formal peer-review is required every three years, whereas ad-hoc observations typically occur once per year. Peer-review evaluations are more likely to detect outdated or inadequate course materials than student evaluation feedback. Both types of peer-review are accompanied by a written evaluation that is also presented to the Chair for further discussion with the instructor. The course proposals are routinely updated and reviewed by the faculty which helps to ensure ongoing assessment of the courses.

Research

All tenured and tenure-track faculty in the program are expected to direct an active extramurally funded research program as evidenced by publications, conference presentations, grant funding and student scholarly accomplishments (See Appendix M & R). In addition to research space, the College provides a generous start-up package for faculty that generally includes two to three years of post-doctoral salary. Core facilities have been significantly strengthened in the past few years (See Section IX). ACPHS encourages faculty to share resources, including lab space, instrumentation and equipment. Intramural seed funding for small research projects is available through the Scholarship of Discovery Grant Program and Rudolph & Dorothy Blythe Research Award. In an effort to further support faculty members, 10% of the indirect costs from all grants, including federal, state, local, and industry grants, are returned to the faculty and 10% to the department. Once a grant is awarded, the Office of Grants Administration, in conjunction with the Finance Office, provides professional assistance related to grant administration, compliance, and accounting.

All faculty meet with the Chair at least once a year to review research plans. New faculty and faculty striving to produce high-quality research will meet with the Chair more frequently and are encouraged to present proposals in a grant camp for critique. In addition, new faculty have a senior faculty mentor who provides feedback on research initiative and grant proposals. Additional off-campus professional development opportunities are available through attending seminars in area's universities, colleges, and research institutions, as well as NIH regional seminars on program funding and grants administration. Departments are also able to provide support for research through their operating budget. These include administrative staff, weekly journal clubs, teaching assistantships to graduate students, research supplies for unfunded faculty and support of travel expenses for faculty members and students to present their research at national meetings such as ASM. The College hosts a Research Seminar Series in which faculty from other institutions are invited to share their research work. The College also has a sabbatical policy which allows faculty members to dedicate a semester to research.

In addition, non-tenure-track faculty in the program have less time to dedicate to research but still offer Independent Study and Capstone projects to BSMB students. Those efforts are largely supported by shared lab space and funds provided by the department. These faculty members provide a significant research experience to the undergraduates and also help in alleviating the workload of tenured or tenure-track faculty members with more research responsibilities.

IX. RESOURCES & FACILITIES

The College has approximately 18000 ft² of research laboratory space that includes approximately 2500 ft² in the Colchester, Vermont facility, 5160 ft² in the O'Brien Building, 6470 ft² in the Biomedical Research Building including 1500 ft² for animal facility, and 3746 ft² for the Pharmaceutical Research Institute (PRI). The BSMB program largely resides in the O'Brien building but faculty and students have access to resources available in the Bioscience Research Building (BRB) and the PRI.

A. O'Brien Building

O'Brien building houses lecture halls, teaching laboratories, research laboratories, administrative offices, and faculty offices. All microbiology, immunology, infectious diseases, cell and molecular biology instructional and research laboratories including core facilities reside in this building. All major items of equipment shared by faculty are covered by a College funded maintenance agreement.

Instructional Microbiology laboratory

The Instructional Microbiology laboratory at the College is approximately 2150 ft² of space in the O'Brien Building. The laboratory is a Biosafety level 2 compliant laboratory fully equipped for conducting all needed labs courses. It is equipped with refrigerators, -80°C and -20°C freezers, autoclave, bacteriological and CO₂ incubators, refrigerated centrifuges, Class II A2 biosafety cabinets, hot air oven, and ultrapure water purification systems. Minor equipment like gel electrophoresis units, power supplies, weighing balances, pH meter, water baths, shaking incubators, BioRad Western blotting transfer systems, electroporator, Eppendorf biophotometer are available in the lab in sufficient quantities to run lower and upper level labs. There is adequate bench space in the laboratory to accommodate 24 students.

Microbiology & Infectious Diseases Research Labs

The Program Director and core faculty in the program have approximately 5160 ft² of Biosafety level 2 compliant laboratory space in the O'Brien Building. Molecular Microbiology resources located in the O'Brien building available for research and instructional use includes Sartorius Stedim Bioreactor, BD FACS Verse flow cytometer, Biorad Quantitative Real-time PCR machine, UV/fluorescence plate readers, EVOS fluorescent microscope, Olympus inverted microscope, BioRad Chemidoc gel imaging systems, Superspeed and ultracentrifuges. A nuclear magnetic resonance (NMR) instrument is also available for use by faculty.

B. Biosciences Research Building (BRB)

The Bioscience Research Building houses multidisciplinary research laboratories and offices for faculty, post-doctoral fellows, and graduate students. Standard equipment such as refrigerated centrifuges, refrigerators, bacteriological and CO₂ incubators, -80°C and -20°C freezers, liquid nitrogen storage, power supplies, balances, pH meter, water baths, shaking incubator, hot air ovens, fume hoods, autoclaves, ultrapure water purification systems, absorbance and fluorescence plate readers, and in-house air are available throughout the laboratories. Molecular biosciences laboratory resources supporting research in cell signaling, infectious disease, DNA, RNA and protein function the BRB include: Class II A2 biosafety cabinets, tissue culture hoods and bacteriological and CO₂ incubators, inverted tissue culture microscopes, Quantitative Real-time and traditional PCR machines, gel imaging systems, Western Blot apparatus, an Olympus IX71 Fluorescence Microscope for live cell imaging, a Microm HM 505E cryostat, facilities for *Drosophila* research including dissection microscopes and fly husbandry, and a Sorvall 6000 super speed centrifuge.

C. Animal Resources Facility

ACPHS maintains a centralized Animal Resources Facility which is housed in the BRB. The facility is licensed by the USDA and the New York State Department of Health, Division of Laboratories and Research. The use of all animal experiments are approved by the institutional animal care and use committee. Appropriate veterinary care and animal husbandry care is provided.

D. Pharmaceutical Research Institute

Founded in 2002, the Pharmaceutical Research Institute (PRI) at Albany College of Pharmacy and Health Sciences is a center for drug discovery and development and houses laboratories with 3746 ft² of laboratory space. PRI investigators possess expertise in fields that include nanotechnology, medicinal chemistry, molecular biology, and cell biology. Areas of focus include: hematology/oncology, cardiovascular (dyslipidemia), ophthalmology, vascular diseases, neurology, and inflammation.

The PRI Microbiology/Molecular laboratory contains Class II A2 biosafety cabinets, bacteriological and CO₂ incubators, chemical fume hoods and storage cabinets, a water purification system, refrigerators and freezers (-30 and -80 °C), fully equipped cell culture facility, Liquid Nitrogen Locator 7 Cryobiological storage system, refrigerated centrifuge and high speed centrifuges, sonicators, pH meters, high speed stirrer, Karl Fisher titrator, reciprocating shaking bath, ELISA plate readers and associated printer, UV/Visible light, fluorescence and spectrophotometer plate readers, and a Leica Microsystems SP5 AOBS UN/405 confocal microscope.

E. Library Facilities

The George and Leona Lewis library on campus has extensive collection of books and periodicals, electronic databases (SciFinder/CAS, Web of Science, *etc.*), and an inter-library loan service. ACPHS has access to the Albany Medical College and The State University at Albany (SUNY) libraries.

The libraries on both campuses provide high quality resources, services and educational experiences to meet students' information needs. The Library supports educational and research activities through access to quality resources in a variety of formats. It provides ample hours of service throughout the year as well as comfortable and engaging spaces with seating for both individual study and collaborative learning. Students may print, photocopy, fax and scan materials in the libraries. Professionals are available on both campuses to provide one-on-one research assistance to students in person and via phone, email and instant messaging. Librarians also collaborate with faculty to plan and deliver formal instruction that develops the skills students need to find, retrieve, analyze and ethically use information. Relevant holdings that support the Program are detailed in Appendix N.

X. PROGRAM SUPPORT

The College has a wide range of student support services including peer tutoring, Science Assistance Center, and Writing Center designed to facilitate student success. Student advising is done by faculty advisors in conjunction with the Academic Class Advisor from Center of Student Success. Additional

information regarding Student Support Services and Student Experiences in the Program are provided in Appendix O & P.

At the programmatic level, the Program Director along with the faculty advisors have regular meetings with the students at least twice a semester. The process of student advising by Program Faculty regarding their track selection and career choices are outlined in Program Outcomes, Section XII.

XI. PROGRAM CAPACITY AND GROWTH

ACPHS is actively seeking increased enrollment in non-Pharmacy programs (all BS and MS programs). At the present time, a preliminary goal is a 10% increase in student matriculation in the BSMB program per year until total program enrollment (over four years) is ~80 students. With increased enrollment in the BSMB programs (and indeed all BS and MS programs), financial aid and recruitment efforts for students (through the Office of Enrollment Management) must be increased and modified as necessary.

A. Faculty

Using the current model in which students are encouraged to participate in research activities, enrollments beyond 15 students per class year will require an increase in faculty teaching efforts in BSMB lab- and research-intensive courses offered in the program. At most, a tenured/tenure track faculty member will accept 2 graduate students, 2 BSMB capstone students and 2 Independent Study students. Non-tenure track faculty members can accept 1 capstone and 2 Independent Study students. With these student numbers, current Program faculty have a capacity to handle approximately 15 students per year.

The capacity of the program has been estimated using the following assumptions:

- Only exceptional first year students (top 25%) have an Independent Study Experience;
- Approximately, 50% second year students will have an Independent Study Experience;
- Approximately, 66% third year students will have an Independent Study Experience;
- Approximately, 66% fourth year students will have an on-campus research based Capstone Experience; rest will have an off-campus research or internship experience.

	Graduate Students	Capstone Students	Independent Study Students
Current Capacity	4/year	12	16
Capacity including new hires	5/year	15	21
Capacity needed for 15 students/ year	N/A	10	22
Capacity needed for 20 students/ year	N/A	14	29

As described more fully in Section XIII, program faculty intend to explore capstone alternatives such as industrial internships, externally mentored capstone projects and non-wet laboratory-based research projects to allow for less resource-intensive expansion of the program.

B. Instructional Space

At the present time, didactic instructional space is not an issue for lecture courses. However, upper level lab sections will need to be added as the program enrollment increases. The implementation of Industrial/Pharmaceutical Microbiology track will require additional lab space as well.

C. Research Space

Research space for BSMB capstone projects has not yet been an issue; however, given the limitations in O'Brien building and a desire to increase enrollment, space for research could become problematic. The research lab space constraints will also pose a problem in attracting and hiring new faculty. Further, growth in the MS Molecular Biosciences program concurrent with increased enrollment in the BSMB program will put a strain on the available faculty and laboratory resources. Co-op/internship opportunities at Regeneron starting from Spring 2019 in place of research intensive Capstone experience will provide students with invaluable training while alleviating some of the resource constraints. This will be a continuous area of assessment and modification over the next three to five years until enrollment reaches its desired level.

XII. PROGRAM OUTCOMES & ASSESSMENT

A. Program Outcomes

The Program places great emphasis on career outcomes of students. Starting from second year onwards, faculty advisors along with the Program Director engage in formal and informal discussions with students about their career goals. Based on their interests, students are placed in appropriate tracks to ensure a successful career outcome.

If the student is interested in pursuing graduate school, they are placed in research labs early in the Program, sometimes even in their first year to do small scale Independent Study Research projects which culminate with a yearlong Capstone Experience in their Senior Year, the results of which are presented to the entire ACPHS community. Students can also apply for Summer Research Award mechanism which provides an excellent opportunity to undergraduate students for conducting research during summer months. Additionally, they are encouraged to give poster presentations in meetings at local and regional level including the Eastern New York Branch of ASM. These opportunities has resulted in four (36%) of our graduates successfully pursuing a Master's degree.

If the student wishes to pursue a pre-med track, their schedule is accordingly designed so that they are fully prepared to do well on MCATs and also stand out in their applications with volunteering and research experiences. They are also advised to contact the Medical School Advisory Committee Chair who serves as an important source of information and advice. Two (18%) of our graduates are successfully continuing their post-graduate education in medical schools.

Students wanting to pursue a career in biopharmaceutical companies after graduation are encouraged to pursue industry internship opportunities. The College has been able to capitalize on the proximity of Regeneron Pharmaceuticals Inc., a rapidly growing biopharmaceutical company right here in Albany, NY. Regeneron has agreed to host 10 co-ops for students from BSMB and BS Pharmaceutical Sciences programs in their Senior Year Spring semester starting from Spring 2019. These joint ventures and networking have facilitated two of our graduates (18%) in securing employment at Regeneron, while two additional students are currently interning at Regeneron this summer.

The core faculty in the Program have active collaborations with researchers in the nearby institutions including the Wadsworth Center, New York State Department of Health, Albany NY. These collaborations have provided additional employment opportunities for our students after completing internships and/or Capstone projects in the New York State Department of Health labs.

Graduates and Alumni Outcomes

Of the 11 students that have graduated from the program to date:

- 7 students are continuing their education.
 - 2 students are pursuing medical school education.
 - 4 students are pursuing a Master's degree at ACPHS.
 - 3 students pursuing a Master's degree in Molecular Biosciences
 - 1 student pursuing a Master's degree in Clinical Lab Sciences
 - 1 student is currently in the process of applying to medical schools.
- 3 students have secured employment after graduation.
 - 1 student is employed as Research Assistant for the Million Veteran Program (genomic biobank study), Veteran Affairs, Albany, NY
 - 1 student is employed as a QC Microbiology Analyst at Regeneron Pharmaceuticals.
 - 1 student is employed as a Research Technician in a New York State Department of Health laboratory.
- 1 student has left the US to live with his family.

B. Student Learning Outcomes

Student learning outcomes are measured by an exit exam, evaluation of the students' capstone projects, assessment of their capstone presentation, and assessment of journal club performance.

Exit Exam

In order to begin assessing the Student Learning Outcomes, an Exit Exam was administered to the Senior Year students during the week of final exams this year. The exam consisted of 50 multiple choice questions in five important areas of didactic coursework: Microbiology, Immunology, Microbial Physiology, Microbial Genetics and Cell Biology (Exit exam provided in Appendix Q). The students were not given any advance notice of the exam to test the long term retention of core concepts in Microbiology and related disciplines.

Exit Exam Results

Content Area	Student 1	Student 2	Student 3
Microbiology	100%	90%	90%
Immunology	100%	100%	80%
Microbial Physiology	80%	90%	70%
Microbial Genetics	80%	90%	90%
Cell Biology	70%	70%	60%
Overall Average	86%	88%	78%

Overall, the graduating students demonstrated a strong comprehension of the core concepts in microbiology and related disciplines. It should be noted that the knowledge assessed had been taught to the students in courses taken in second and third year which suggests that initial information has been reinforced in the advanced courses of the curriculum. The Exit exam assessment data will be collected every year for all graduating students.

Capstone project and presentation

The BSMB curriculum includes a required 6-credit undergraduate capstone research project. This experience is made up of two sequential three-credit courses usually taken during a student's senior year in the program. The project combines aspects from all areas of the curriculum, including scientific reasoning, critical thinking, and communication skills (both oral and written) and is a critical component in completion of the BSMB program objectives (Section IV and Appendix E). At the end of this undergraduate research experience, students are required to present their research to the ACPHS community. A Capstone Project and Presentation rubric has been designed to assess the scientific, critical thinking, and communication skills of the students (Rubric provided in Appendix Q). The Presentation rubric was used by all the Program faculty members to score the student presentations.

As demonstrated in the table below, two students exceeded expectations in all programmatic objectives of scientific thinking and communication skills measured; while one student met the expected standards. This assessment data will be collected annually for all future capstone presentations.

Capstone Project Results

	Question	Student 1	Student 2	Student 3
Hypothesis and/ or Statement of the Problem	1A	2.83	2.5	2.25
	1B	2.67	2.5	2.75
	1C	2.67	2.2	2.25

Project Approach	2A	3.0	2.2	2.5
	2B	2.67	2.33	2.25
	2C	2.67	2.2	2.4
Results and Project Outcome	3A	2.33	2.2	2.25
	3B	2.6	2.25	2.25
	3C	2.8	2.0	2.63
Oral Presentation	4A	2.5	2.8	3.0
	4B	3.0	2.67	3.0
	4C	2.83	2.6	3.0
	4D	3.0	2.6	2.75
Overall Presentation & Handling of Questions	5A	2.8	2.33	2.5
	5B	2.5	2.83	2.5
	5C	3.0	2.2	2.33
	5D	2.6	2.8	2.75
	5E	2.5	2.67	2.63
	5F	2.33	2.43	2.25
AVERAGE		2.70	2.44	2.54

1.0-1.5: Below Expectations

1.5-2.5: Meets Expectations

2.5-3.0: Exceeds Expectations

Journal Club Performance

Students are required to enroll in a 1+1 credit Journal Club sequence as a co-requisite course with their Capstone Experience. The course objectives of Journal Club are to train students in performing literature searches, critically evaluating primary literature and summarizing and presenting scientific findings to an audience. This is achieved by a series of student presentations and report in both the semesters of their Senior Year. These scientific thinking and communication skills are assessed by the instructor and the rest of the faculty attending the journal club using a grading rubric. The detailed Assessment methods and evaluation rubric are provided in Appendix Q. In future, the data from these evaluations will be collected and analyzed to measure individual and group learning outcomes.

Student Scholarly Accomplishments

BSMB students routinely participate in research projects via Independent Study, Capstone Experience, and Summer Research Award mechanisms. The table on the following page shows the numbers of students enrolled in research intensive courses in the last five years.

Independent Study and Capstone Enrollments
(BS Microbiology students only)

Year	Fall		Spring	
	Independent Study	Capstone	Independent Study	Capstone
2013 - 14	2	0	2	0
2014 - 15	3	1	8	1
2015 - 16	2	4	7	5
2016 - 17	4	4	4	3
2017 - 18	3	5	3	3

Students present their research findings in the Annual Student Research Symposium Day organized by the School of Arts and Sciences or at other regional and national conferences (including ASM). Students in the BSMB program have been quite competitive in receiving Summer Research Awards every year to conduct research in faculty mentor's labs for 8 weeks during summer. Being a primarily undergraduate teaching focused institution, faculty members in the department are eligible for R15 mechanism of grant funding from NIH. A primary criteria of funding through this mechanism is to expose undergraduates to meritorious research that sets them to a path of biomedical research career. Two core faculty members (Malik, LaRocca) have been awarded R15s which is a testament to the undergraduate training environment in the Program. Scholarly Accomplishments of students are summarized in the table below (details provided in Appendix R).

Student Scholarly Accomplishments

Year	Publications	Presentations in regional & national conferences	Presentations in Research Symposiums at ACPHS	Summer Research Awards
2018	1	2	5	2
2017	1		5	2
2016		4	5	1
2015		1	2	1
2014			3	

As evidenced in the table above, these scholarly accomplishments are a reflection and consequence of the quality of didactic preparation and ample hands-on lab and research training provided throughout their curriculum beginning from first year onwards.

Student Assessment of Teaching

Student evaluations form an important part of the assessment of teaching quality. All student evaluations for core courses taught by microbiology faculty are far above the departmental and College averages (table given on the following page). These student evaluations are a testament to the quality of instruction provided by the faculty members in the Program.

Summary of Student Evaluation Results
Core Courses taught by Microbiology Faculty – scores out of 5

Semester	Courses	Q1	Q2	Q3	Q4	Q5	Q6	Q9	Q10	Q11	Average
Fall 2016	Microbiology Microbiology Lab Microbial Physiology Biomedical Lab Techniques I	4.92	4.91	4.91	4.83	4.89	4.89	4.87	4.84	4.83	4.88
Spring 2017	Cell Biology Cell Biology Lab Virology Biomedical Lab Techniques II Bacterial Pathogenesis	4.72	4.81	4.73	4.73	4.64	4.68	4.69	4.73	4.76	4.72
Fall 2017	Microbiology Microbiology Lab Microbial Physiology Biomedical Lab Techniques I	4.68	4.79	4.66	4.64	4.65	4.71	4.69	4.74	4.50	4.67

Questions

- 1 - The instructor was well prepared and organized for class.
- 2 - The instructor demonstrated interest in students and their learning.
- 3 - The instructor communicated information and concepts clearly.
- 4 - The instructor encouraged independent student learning.
- 5 - The instructor was available outside of class time.
- 6 - I learned a great deal from this instructor.
- 7 - Open ended question.
- 8 - Open ended question.
- 9 - The instructor motivated me to learn the material.
- 10 - The instructor answered questions clearly or found ways to help students answer their own questions.
- 11 - The instructor provided grades and feedback in a timeframe that benefited future preparation.

C. Future Assessment Plan

Microbiology has advanced rapidly in recent years. Our program is constantly evolving and the curriculum and new course offerings reflect current developments to better serve its students' diverse needs and adequately prepare those students for meaningful careers in healthcare and research. New developments in infectious disease research necessitate course updates to adequately prepare students for these post-graduate fields.

Ongoing curriculum assessment will include continuing to monitor ASM recommendations. Course proposals with updated content will be submitted for review and approvals to curriculum committees on a regular basis (all recently revised course proposals are attached as a separate Appendix). In

addition to Exit Exam scores and Capstone Experience evaluation, future assessment of the curriculum will include mapping exam questions to student learning outcomes in individual courses. MCAT scores, analysis of graduate and medical school acceptance rates, and student satisfaction surveys regarding curriculum will be additional criteria for future assessment.

Other BSMB Program specific assessment measures include Program Outcomes, Program Reviews every 3-5 years, alumni tracking, student course evaluations, peer evaluations, and faculty development as described previously. Assessment results regarding the BSMB program will continue to be communicated to BCS faculty or other constituents associated with the program at regular department and school meetings as appropriate.

XIII. CONCLUSIONS AND RECOMMENDATIONS

A. Strengths and Major Achievements

Strengths of the BSMB program include a rigorous curriculum grounded in the recommendations of the ASM. Faculty provide research opportunities for students that commonly result in disseminated scholarly works. The didactic instruction and laboratory experiences, when coupled with these research opportunities, ensures the appropriate development of the students. The creation of a dual degree option (BS Microbiology/ MS Molecular Biosciences) provides a seamless internal option for students wishing to pursue graduate studies.

The program is supported by a committed and qualified group of faculty with demonstrated teaching and research expertise. All of the eight faculty associated with the program have terminal degrees and postdoctoral experience in relevant fields. Collectively, they provide a vast majority of the coursework for the program; all of them are research active; four of them are funded. Beyond this core of faculty, the program has adequate support from the Department of Basic and Clinical Sciences, the School of Arts and Sciences, and the College as a whole. Faculty from the other departments on campus provide both General Education coursework and elective options for the Public Health Microbiology Track. Academic and Student Support Services provided by the Office of Student Affairs assist students working through the program.

Well-equipped instructional laboratories, research laboratories, and core facilities represent strengths of the program. Through their coursework and interactions with faculty members, students have routine access to all of the research grade equipment necessary to complete research projects and to prepare them for their future careers.

Initial program outcomes are exceptionally positive and span all the anticipated career options of the program. Graduates from the program have secured admissions in graduate and professional schools and have gained employment in biopharmaceutical companies. Student learning outcomes are likewise positive. Exit assessments indicate strong retention of the core concepts of microbiology along with the development of excellent scientific reasoning, critical thinking, and communication skills.

B. Weaknesses and Remediation Plans

Although a few topics related to Microbial Diversity and Ecology are discussed in other courses, the program curriculum does not have a full course in this area. Given the focus of the program and specialization of faculty in Biomedical Microbiology, addressing this deficiency is not a high priority. The Program currently has a limited number of electives in the Public Health Microbiology/Infectious Disease Epidemiology track. As new faculty hires are made in the Department of Population Health Sciences, more elective offerings will be available.

The Program has seen a low retention rate due to a number of reasons including academic dismissals, internal transfers to other programs more suited to the students' academic abilities, and transfers to other institutions. Strategies outlined in Section VIIC including sending preparatory materials in summer prior to being a freshman, offering more course remediation opportunities, and easing the academic schedule in first semester will help in improving student performance and increasing retention.

While current faculty and facilities are sufficient for the number of enrolled students, there is limited capacity for enrollment growth. This is mainly due to a desire to maintain resource-intensive research based capstone and independent study experiences. Less resource intensive alternatives such as industry internships, capstone mentoring by external researchers, and non-laboratory based research projects will need to be explored if the program is to grow without a significant investment in hiring new faculty.

Due to smaller number of students in the Program, most assessments were done in an informal way. However, from 2017-2018, we have initiated formal assessments of Learning Outcomes. The faculty in the program have also started the exercise of mapping individual exam questions or other assessment methods to specific learning outcomes within each course. We hope to complete this task by the end of next academic year.

C. Plan for Program Improvement

The most obvious area of growth is in the Industrial/Pharmaceutical Microbiology track of the Program. While the development of this track was not initially a priority, recent interactions with Regeneron Pharmaceuticals Inc. have prompted a greater focus on industrially relevant topics such as monoclonal antibody technology, bioprocess manufacturing, good manufacturing practices, and quality assurance/quality control. This relationship has already resulted in an agreement from Regeneron to offer our students summer internships and paid co-op experiences during the semester. By committing 0.5 FTE, utilizing the existing strengths of faculty members in the department of Pharmaceutical Sciences, and expanding the relationship with Regeneron Pharmaceuticals, we anticipate being able to offer this track in the near future.