Bachelor of Applied Science in Molecular Biosciences

August 2014

Form C: Cover Sheet New Degree Program Proposal

Program Information

Institution Name: Bellevue College
Degree: Bachelor of Applied Science – Molecular Biosciences
CIP Code: 26.0210
Existing technical associate degree(s) that will serve as the foundation for this program:
Degree: AAST-Molecular Sciences Technician **CIP code: 41.0101 Year Began:** 2014
Degree: AAS-T- Allied Health **CIP code: 51.0000 Year Began:** 2014

Planned Implementation: Fall 2016

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08/29/14

Chief Academic Officer Date

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Introduction

Bellevue College is planning to implement a bachelor's of applied science (BAS) in **Molecular Biosciences (MBS).** Molecular Biosciences encompasses the study of the molecules that build living cells and organisms and of the complex network of chemical reactions and physical processes that connect them. This field provides the foundation needed to work in a variety of disciplines such as molecular biology, medicine, forensics, biochemistry, pharmacology, neuroscience, food chemistry and environmental science.

Graduates will be prepared to work as entry-level laboratory scientists in bioscience research with employers such as the Fred Hutchinson Cancer Research Center; in pharmaceutical development with companies such as Amgen; and in life sciences product development with companies such as LabConnect. Graduates will have a thorough understanding of the scientific disciplines underpinning molecular biosciences, as well as extensive laboratory experience using state-of-the-art equipment. They will also bring understanding of the complex regulatory environment surrounding the biosciences as well as the business skills needed to manage a project and/or the purchasing and tracking for a lab or a study.

Feedback from local employers and employment predictions led to the college's focus on the molecular biosciences. This applied degree differs significantly from the traditional undergraduate science degree in several ways, including:

1. focus on developing a solid scientific background that becomes the foundation for applied laboratory skills;
2. extensive laboratory work with state-of-the-art technologies to foster the development of independent laboratory skills;
3. familiarity with reading, understanding and discussing research papers in molecular biosciences through participation in the Molecular Biosciences Seminars;
4. exposure to project management and general business skills for laboratory settings;
5. coursework on the regulatory and legal environments within which the molecular biosciences operate;
6. preparation for immediate employment through a capstone project in a laboratory setting.

The BAS in Molecular Biosciences is part of Bellevue College's plan to fulfill the 2011 legislative proviso that states: *Bellevue College is authorized to offer applied baccalaureate degrees in information technology, healthcare services and management, **biotechnology,** and preprofessional preparation for medical fields.*

Students may enter the BAS in Molecular Biosciences from several feeder programs, available at Bellevue College and other system colleges. Bellevue College has developed and implemented a new Molecular Sciences Technician AAS-T (MST) as of fall quarter, 2014. Graduates of this new two-year degree will be well prepared to progress into the BAS in Molecular Biosciences. In addition to providing a unique opportunity for any student interested in science, the new Molecular Sciences Technician AAS-T degree will provide a

degree-completion opportunity for the significant number of students who have prepared for an allied health program, but, due to the limited space available in many of those programs, have not been admitted. Many of these students have a large number of science-related credits, no two-year degree, and few or no options for transfer. Through building on the foundation of science credits they have accumulated, the Molecular Sciences Technician AAS-T will provide these students with a pathway to work or to continued education. In addition, both Shoreline Community College and Bates Technical College have two-year degrees in Biotechnology that prepare students either for work or for progression into this degree program.

Curriculum Demonstrates Baccalaureate-level Rigor

Program Learning Outcomes

Bellevue College has carefully designed the overall curriculum scope, as well as individual courses, to help students gain the knowledge, skills and abilities they need to be successful in careers based upon a solid foundation in molecular biosciences. In particular, students in this program will need to demonstrate the breadth and depth of their educational preparation through the successful completion of an individual capstone project (practicum). Successful graduates of the program will meet all course and program learning outcomes.

Program graduates should be able to:

- Integrate laboratory skills and theory into job-related tasks
- Apply the scientific method and good experimental design in the workplace
- Read, understand, and carry out protocols and use appropriate laboratory equipment with minimal supervision
- Analyze and summarize scientific data using analytical and computational tools
- Communicate scientific ideas in either written or oral formats in a manner that is appropriate for either a technical or non-technical audience
- Apply working knowledge of industry regulations and guidelines, in the context of good laboratory practice, quality control and regulatory issues
- Appraise societal, economic and ethical issues related to their area of expertise
- Engage in continuing professional development through lifelong learning

Course preparation for students transferring with a technical associate degree

Students with technical degrees in Biotechnology, Molecular Science Technology, General Science Technology, or similar, are well prepared for the BAS in Molecular Biosciences. In keeping with the open access mission of the community college, admission requirements have been designed to provide access to many and to ensure that prospective applicants are prepared for success once they enter the program. Table II, below, provides detail.

TABLE II: ENTRY REQUIREMENTS FOR MOLECULAR BIOSCIENCES DEGREE		
Prerequisites	**Notes (all listed classes are quarter courses)**	**Credits**
Associate degree in biotechnology, molecular science technician, general science technician, or equivalent	Courses must include: College level statistics (MATH 130 or equivalent); Calculus I & II (MATH& 151-152[1] or equivalent); English Composition (ENG& 101 or equivalent); Technical Writing (ENG& 235 or equivalent); 3 quarter General Chemistry sequence (CHEM&161-161-163 or equivalent); Instrumental Analysis (CHEM 275 or equivalent); General Biology or Majors Biology (Cellular) (BIOL&160 or BIOL& 211 or equivalent); Laboratory Methods in Genomics (BIOL 275 or equivalent); 2 science electives (with lab); Presentation Design and Delivery (BTS 147 or equivalent); Communication Studies (CMST 250 or 280 or equivalent); one humanities course and one social sciences course.	90
Cumulative GPA of 2.0	In all college courses	
General education courses	At least 30 credits, as outlined in Table III, general education requirements.	Included in 90 above

General Education Components of the degree

Bellevue College has planned carefully to ensure that general education credits and courses meet state guidelines for general education within applied baccalaureate degrees.[2]

All BAS in Molecular Biosciences degree graduates will have taken 60 credits of general education, 25-40 credits of which have typically been satisfied at the associate-degree level as confirmed by entrance prerequisites. The remaining credits are satisfied at the upper division level by courses in philosophy, science, and others as needed. General education requirements for the degree are outlined in Table III (next page).

[1] Course numbers with an ampersand symbol (&) are common course numbers at all Washington State community and technical colleges. Course numbers without the ampersand symbol refer to Bellevue College courses.

[2] http://www.sbctc.edu/college/e_appliedbaccalaureates.aspx 07.01.2013 Minimum of: ten credits of written communication skills, including English composition; five credits of quantitative skills; ten credits of humanities; ten credits of social science, including a communication studies course; and ten credits of natural science, including at least one life sciences course and one course with a lab.

TABLE III: GENERAL EDUCATION REQUIREMENTS IN MOLECULAR BIOSCIENCES			
Subject	**Credits**	**Met by prerequisite**	**Met in baccalaureate**
Communication Skills (Eng. Comp. required)	10	ENGL&101 English Composition	
		ENG 235 Technical Writing	If not taken in associate degree
Quantitative Skills (college level math)	5	MATH 130 Intro to Statistics	If not taken in associate degree
Humanities	10	CMST 250 or 280 Satisfies Cultural diversity requirement	If not taken in associate degree
		Student choice from list	If not taken in associate degree
Social Science	10	BUS& 101 Intro to Business	If not taken in associate degree
		_____	Ethical conduct in research and biomedical industry
Natural Sciences (one lab, one life)	12	CHEM 275	
		BIOL 275	
Other	10	MATH&151, 152	
Total required	**60**		

Upper division coursework

The BAS in Molecular Biosciences is being designed with working students in mind. Some of the courses are taught through a hybrid model in which degree candidates spend some class time face to face with the instructor and some class time online. Several of the seminar-type courses will be taught online. All students take the same core technical, science and mathematics courses. Students take at least 10 credits from a variety of elective classes as outlined in Table IV (next page). Total program credits are at least 181. The exact number depends on the specific elective courses taken by the student.

TABLE IV: MOLECULAR BIOSCIENCES UPPER DIVISION COURSEWORK	
Core technical courses – all students take:	**Credits**
General Physics I & II	12
Organic Chemistry I, II, III	18
Biochemistry I, II	10
Cell Biology and Genetics and Bioinformatics (hybrid)	15
Advanced Methods in Molecular Biology	6
Introduction to Data Analytics (online/hybrid)	5
Practicum	10
Molecular Biosciences Seminar (can be repeated up to 3 times for credit)	2
Upper division electives- students take at least 12 credits from the following courses:	
Introduction to Patent Law (online seminar)	2
Introduction to Biomedical and Biotechnology Regulations (online seminar)	2
Biology of Cancer (hybrid)	5
Immunology	5
Microbiology	6
Anatomy and Physiology I and II	12
Project planning, tracking and reporting (online)	5
General Education – all students take:	
Ethical conduct in research and biomedical industry (hybrid)	5
Humanities or social science if needed	5-10
Total General Education	28-38
Total BAS in MBS coursework	90-100

As noted above, students attending full-time, which is typically three courses or 15-18 credits each quarter, finish the program in six quarters. Program faculty and the program manager will work with each student to develop an appropriate academic plan, ensuring that full-time and part-time students are able to efficiently meet their graduation goals.

TABLE V: SAMPLE FULL-TIME MOLECULAR BIOSCIENCES STUDENT SCHEDULE			
First (junior) year			
Fall	**Winter**	**Spring**	**Summer**
General Physics I	General Physics II	Genetics	
Organic Chemistry I	Organic Chemistry II	Organic Chemistry III	Humanities or social science, if needed
Cell Biology	Bioinformatics	Int. To Data Analytics	
Second (senior) year			
Fall	**Winter**	**Spring**	**Summer**
Biochemistry I	Biochemistry II	Practicum	
Advanced Methods in Molecular Biology	Practicum Molecular Biosciences Seminar	Ethical Conduct in Research and Biomedical Industry	Practicum, if needed
Advanced Elective	Advanced Elective	Seminar	

Graduation Requirements

In addition to eligibility requirements, students must complete a total of at least 90-100 applicable college-level credits in the program. Students will also be required to maintain a cumulative GPA of 2.5 for all core courses and a minimum of 2.0 in each individual core course (see the list on Table IV, previous page) including equivalent credits transferred from other colleges. Students will be allowed to repeat a course to improve their GPA. At least 45 quarter credits from the core courses must be completed in residence at BC.

We strongly believe that a lower cumulative GPA requirement would prove to be a disservice to the graduates of the program. In a field as competitive as Molecular Biosciences performance at a level below this GPA is unlikely to translate into obtaining a job and keeping it. It is worth noting that entrance to the majority of graduate programs requires a cumulative GPA of 3.0. One of the goals of the BAS in MBS at Bellevue College is to offer a degree that would lead to good entry level positions for its graduates and that would also allow them to continue their education at a more advanced level if they wished to do so. By aligning Bellevue College's grade expectations with the rigorous demands of a competitive workplace and the entry requirements to graduate school programs we are keeping the best interests of our students at heart.

Program evaluation criteria and process

Assessment for the proposed Molecular Biosciences program is based on the comprehensive student achievement and program assessment processes in place at Bellevue College for all programs, including associate and baccalaureate degrees. Program review occurs every five years and provides a thorough assessment of every aspect of the program. It includes strategic planning; student headcount, full-time equivalent student (FTES) and schedule trend analysis; program enrollment data, including student faculty ratios, analysis of full-time and part-time faculty ratios and other staffing indicators; student performance evaluation; an evaluation of curriculum coherency and currency; program viability, including employment placement data and market analysis; and analysis of student demographics, program costs and revenues, retention and advising, articulation agreements, and course delivery methods.

Until the first five-year program review occurs, staff will evaluate the Molecular Bioscience program's effectiveness by collecting and analyzing data annually on student satisfaction, preparedness, and retention; faculty assessment of student preparedness; and effectiveness of courses to meet the program outcomes. Table VI (next page) summarizes assessment mechanisms.

Industry will engage in recommendation and review of the curriculum and program elements through the program advisory committee. This is a new advisory committee, being established with professionals from the field of molecular biosciences. The advisory committee's role will be to advise the program on recommended curriculum improvements; help keep the program abreast of changes in the field; assist in student

recruitment and placement; and make recommendations for other changes that will keep the program current.

TABLE VI: PROGRAM ASSESSMENT	
Effectiveness of curriculum/ program — continuously refines curriculum and program design, keeping the program current, including discipline-based, general education and elective courses.	
Course evaluations by students	• Effectiveness of curriculum & teaching methods in courses • Effectiveness of program in skills & knowledge progression
Capstone evaluation by employers and students	• Adequate balance of knowledge & skills, theory & practice • Effectiveness of program in meeting students' expectations • Effectiveness of program in meeting employers' expectations
Annual student survey	• Effectiveness of the program in skills & knowledge progression • Adequate balance of knowledge and skills, theory & practice • Effectiveness of program in meeting students' expectations • Effectiveness of institutional and program resources and support • Preparedness of faculty • Preparedness of students upon entering individual courses
Program statistics	• Student retention • Student course success • Student progression through program
Survey of MBS program faculty	• Preparedness of students upon entering individual courses • Preparedness of students upon entering the program
Graduate follow-up and industry feedback — assesses effectiveness of program in meeting career goals and employer expectations and uses findings to refine curriculum and teaching methodologies	
Survey of program graduates nine months after graduation	• Effect of program completion on career • Effectiveness of program in meeting job expectations • Wage and career progression
Survey of employers of program graduates nine months after graduation	• Effectiveness of program in meeting job expectations • Observed increased skills and performance • Perceived strengths and weaknesses of current program
Oversight by Advisory Committee – provides ongoing support and program review	
Molecular Biosciences Program Advisory Committee	• Completeness & relevance of curriculum to employer needs • Trends in field, technologies, practices and job markets
Survey of faculty satisfaction — assesses adequacy of program support and faculty training	
Survey of program faculty	• Effectiveness of institutional & program resources & support • Preparedness to teach the curriculum
Impact on two-year program — assesses impact of program on Molecular Sciences Technician	
Survey of students enrolled in the Molecular Sciences Technician program	• Impact of BAS in MBS on the quality of the two-year degree • Impact on faculty availability and support • Impact on institution & program resources & support
Survey of faculty teaching the two-year associate degree program	• Impact of BAS in MBS program on the quality of the two-year degree • Impact on faculty availability and support • Impact on institution & program resources & support

Qualified faculty

Bellevue College projects 9 FTE enrollment during 2016 (year 1 of the BAS in MBS), with full capacity achieved by 2020 with FTE of 31. To support this number of students, the program will need 1.5 new full-time equivalent faculty (FTEF) by 2016. This includes several new part-time faculty as well as a program chair. Faculty teaching general education courses will teach these courses as part of their ongoing load, so no additional faculty will be required in areas outside the sciences. All faculty teaching in the program will be required to hold a minimum of a master's degree.

TABLE VII: FACULTY PROFILES

Faculty Name	Credentials	Status	Course(s)
Brett Goldston	MS	FT	Organic Chemistry I, II, III
Jennie Mayer	MS	FT	Organic Chemistry I, II, III
Dan Mitchell	PhD	FT	Organic Chemistry I, II, III
Staff	Varies	FT and PT	General Physics I, II
Staff	Varies	FT and PT	Molecular Biosciences Seminar
Staff	Varies	FT and PT	Practicum
Staff	Varies	FT and PT	Microbiology
Staff	Varies	FT and PT	Anatomy and Physiology
Gita Bangera	PhD	FT	Advanced Methods in Molecular Biology
Jacqueline Drak	PhD	FT	Biochemistry I, II
Chris Shelley	PhD	FT	Biochemistry I, II
Jim Ellinger	PhD	FT	Biology of Cancer
Winnie Li	MS	FT	Introduction to Data Analytics
New FTEF, 1.5	TBD	To be hired, 2015	Cell Biology, Genetics, Bioinformatics, Advanced Methods in Molecular Biology, Introduction to Biomedical and Biotechnology Regulations, Introduction to Patent Law, Immunology, Molecular Biosciences Seminar, Ethical Conduct in Research and Biomedical Industry
Staff	Varies	FT and PT	Additional Electives

Selective Admissions Consistent with Open Access Institution

Although the new degree will employ a selective admissions process, it will be consistent with the college's open access philosophy. Qualified applicants who meet the priority due date will receive first consideration. If there are more program slots than applications, applicants who do not meet the priority due date will be considered. Should there be more qualified applicants than there are openings in the program, the college will first consider offering additional course sections, if feasible. If there are more qualified applicants than

there are openings, but not enough applicants to add an additional section, or another section is not feasible, the college will place any remaining qualified applicants on a wait list. Admission of students placed on the wait list will be determined based on the date when they were wait-listed. The program will assess this process each year and determine if changes need to be made, based on student progress and retention, diversity of student group, and other factors as they emerge.

The bachelor's program will employ practices implemented by the college's Office of Equity and Pluralism to attract a diverse student population to the college. These include:

- Recruit persons of color who are BC program graduates and professionals to serve as role models, serve on the Advisory Board and make presentations to currently enrolled associate degree students to encourage them to pursue the new degree;
- Engage in targeted marketing and through mailed marketing materials to encourage persons of color and those from underserved populations to apply to the program;
- Recruit students from underserved populations from the STEM cohort at BC;
- Coordinate program diversity efforts with the institution's office of Multicultural Services;
- Apply best practices for identifying potential hires from underrepresented groups;
- Regularly assess recruitment/retention efforts with regard to underrepresented populations, and continually monitor and strive to improve the program's culture of appreciation and respect towards diversity.

Once the degree is approved, the Bellevue College Foundation will begin discussions with local businesses to create program scholarships to assist those that could otherwise not attend. Students will also be able to apply for existing BC scholarships that serve financially disadvantaged students and students of color.

Student enrollment

Based on the enrollment patterns of Bellevue College's existing applied baccalaureate programs, it is expected that about half of the students will attend full-time. Of those attending part-time, the majority will carry ten credits per quarter and complete the degree within nine quarters.

TABLE VIII: BAS IN MOLECULAR BIOSCIENCES ENROLLMENT PROJECTIONS

Year	1 2016-17	2 2017-18	3 2018-19	4 2019-20	5 2020-2021
Headcount	12	24	34	38	44
FTES	9	18	24	27	31
Graduates	0	6	12	14	16

Recruitment and Facilitation of Articulation Requirements

The SBCTC awarded BC a one-year grant to work together with local area school districts to start creating a STEM pathway from high school into the MST degree (and by extension into the BAS in MBS). Once established this pathway would be an instrumental step in facilitating the access of high ~~schol~~school students to the new degrees. As a result of this grant funding high school and BC instructors met several times to review and discuss curriculum alignment possibilities. They also developed and delivered a one-week, hands-on workshop for high school students interested in pursuing a career pathway closely related to the MST degree (which will feed into the BAS in MOS).

BC staff plan to meet this fall with local high schools (for the MST) and potential feeder colleges (for the BAS in MBS) to discuss admission requirements and disseminate appropriate marketing materials. Recruitment will be conducted through the Bellevue College website, at area businesses, and through information that will be shared through statewide lists of Instructional and Student Services Vice-Presidents and Workforce Deans.

Appropriate student services plan

As an open access 4-year college, one of BC's strengths is the variety of student-focused support services that help students achieve success in accomplishing their goals. Students in the Molecular Biosciences program will be supported by the same high-quality student services that all students receive.

As Bellevue College has added new applied baccalaureate degrees, the college has focused on integrating support for baccalaureate students across the institution. For example, additional FTE have been added in enrollment services to provide transcript evaluation for incoming applied baccalaureate students. Similarly, program advisors for applied baccalaureate degrees assist students who wish to continue to master's degrees with the transition. Beginning in academic year 2013-14, the library has added 1.0FTE librarian assigned specifically to the bachelor's degree programs, which provides another institutional touch point for students. All self-support baccalaureate programs return a portion of the tuition paid to the college to provide program support to baccalaureate students.

Access to student services

In order to ensure access to program advising, the program manager will be available for appointments close to class time, in addition to availability by email. The program manager is the central point-of-contact for students, from before admission, through the program, and into graduate school or the workplace. This model has worked well in Bellevue College's other applied baccalaureate degrees, and the college plans to continue it for future degrees.

To provide convenient access to all students, Bellevue College has numerous services available electronically, including online registration each quarter; online tutoring; 24/7 access to librarians through "ask a librarian"; extensive research databases suitable for baccalaureate-level research; and degree audit and transcript request. For face-to-face connection with all students, many services have evening and/or weekend hours, including the academic success center, including the math lab, the writing lab, and the science study center; counseling center; disability resource center extended testing hours; financial aid, and the library.
The following services will be those most frequently used by baccalaureate students.

Student Advising, Retention and Success: The model that has worked well for the college's baccalaureate programs and will be used for the new degree is an imbedded program manager who works one-on-one with students to facilitate their success. The manager assists students with their educational planning and progress towards degree completion while supporting the program chair and faculty who conduct academic advising. Each student will have an individualized schedule and advising plan. Students can use internet advising services and degree planning worksheets to access their information. The online degree planning tool helps faculty advisors and students evaluate, monitor and track the student's progress toward completion of a degree. Student retention and student success are the college's top priorities. Students appreciate and respond to having a specific person they can go to for assistance. Program faculty will work with students who need additional assistance to develop personalized student success strategies.

Academic Success Center (ASC): The ASC assists students in successfully completing their college courses through one-on-one and group tutoring, workshops, classes and open labs in reading, writing and math.

Computer Labs: BC provides a wide variety of specialized computer and learning labs to enhance learning and student success as well as a 200-computer open lab.

Credentials Evaluation: Full-time credentials evaluators have extensive experience evaluating transcripts from accredited institutions. They will evaluate incoming students for compliance with admission requirements and student records for all degree requirements when students approach graduation. Bellevue College is committed to providing efficient time-to-degree for students, and makes every effort to accept prior learning when appropriate.

Disability Resource Center (DRC): The DRC provides assessment and accommodations for students with documented disabilities. They provide special course materials, coordinate testing for disabled students and assist faculty in providing appropriate accommodation.

Financial Aid: The financial aid office prepares and disburses federal, state, and institutional aid for all BC students. Students can monitor the process of their application online.

Job Placement: Providing help with career advancement and job placement will be priorities for the new BAS. An effective advisory board comprised mostly of regional experts in the different fields related to molecular biosciences and potential employers will help to identify jobs. Through the required capstone course, students will develop potential job contacts. The Center for Career Connections has been successful in helping students find jobs by providing career planning and job placement assistance and conducting career fairs.

Multicultural Services (MCS): MCS offers advising and mentoring, tutoring, emergency financial assistance, and support for the college's multicultural student population.

Online Services: All students have online access to the bookstore, records and grades, registration, advising, faculty communication, and library services. As an example of integrated services, the library has added extensive online collections and resources. Library faculty have also developed upper-division research workshops for students in applied baccalaureate programs. The distance education office provides extensive technology assistance and student services for all online students.

TRiO: Students who are first-generation college, low-income, or have a documented disability receive academic and personal support. Services include tutoring, study skills, advocacy, and laptop computer lending. The Department of Education has approved extension of this program to all bachelor's degree students who fit eligibility criteria.

Veteran's Administration Programs: The Veterans Affairs Office assists all eligible veterans, reservists, dependents, and VA chapter 31 students.

Appropriate staff and administration

Bellevue College implemented its first applied baccalaureate degree in 2007, a second program in 2009, a third in 2012, and two in fall of 2013. The college has been assessing and adjusting the model for program administration as more programs are added, which has led to the following adaptations.

Program chair responsibilities are typically filled by full-time faculty members. In addition to managing the program, the BAS in Molecular Biosciences chair will teach two courses

per quarter, providing valuable connection to and insight into many aspects of the program. Administrative responsibilities for the faculty program chair include:

- curriculum development, revision, and implementation;
- advising of students;
- marketing the program to new students;
- conducting articulation with both two-year and graduate programs;
- initiating employer outreach;
- participating in college governance; and
- engaging in ongoing program assessment to maintain the program's currency.

The advising section in the student services plan states that educational planning will be handled locally from within the program by the Program Manager. The Program Manager will also

- provide information about the program to prospective applicants;
- monitor student progress;
- guide students to other available student services to aid in their success;
- assist students with advising or course issues.

The Program Manager position is a full-time exempt position. It will also provide administrative support for the program, its chair and the faculty. This model has worked well in the college's existing baccalaureate programs.

TABLE IX: ADMINISTRATION AND STAFF

Name	Title	Responsibilities	Program Effort %
TBD	Program Chair	Manage BAS program, conduct program assessment, hire faculty, oversee budget, market program, oversee admissions, implement recommendations of advisory committee (33% administration; 66% instruction)	33%
Sarah Fisher	Program Manager	Provides administrative support to chair, faculty and students Provides student services assistance to applicants and students to promote student success	100%
Total staff FTE			**1.33**

Commitment to build and sustain a high quality program

The BAS in Molecular Biosciences degree will be funded as a self-support program. The tuition will be set at the same level as state-funded applied bachelor's degree programs, which for 2013-2014 is $245.45 per credit. There will be several offerings of online and hybrid classes, but due to the emphasis on laboratory work with modern equipment, many courses can only be offered on site. Specialized instructional resources will include library

subscriptions to scientific periodicals and software licenses (as needed). Funding has been included in the budget to cover the annual expenses associated with these resources. Bellevue College is committed to the long-term success of the new degree and will set aside funds to launch and fund the program until it collects adequate tuition to be fully self-sufficient. Estimated program expenses and income are detailed in Table X.

TABLE X: BAS MOLECULAR BIOSCIENCES: ESTIMATED PROGRAM EXPENSES						
	Year 0 (FY 15)	Year 1 (FY 16)	Year 2 (FY 17)	Year 3 (FY18)	Year 4 (FY19)	Year 5 (FY20)
Administrative Salaries (1 FTE)	49,000	49,000	49,000	49,000	49,000	49,000
Program Chair (33%) and Part-time Faculty Salaries	0	33,000	53,000	53,000	53,000	53,000
Curriculum Development Stipends	11,000	11,000	4,000	4,000	4,000	4,000
Benefits	8,820	14,760	18,360	18,360	18,360	18,360
Goods and Services	5,000	5,000	5,000	5,000	5,000	5,000
Library subscriptions	15,000	18,000	18,000	20,000	20,000	20,000
Travel	5,000	5,000	3,000	3,000	3,000	3,000
Equipment	40,000	40,000	10,000	10,000	10,000	10,000
Indirect	0	7,953	18,882	31,810	44,733	68,481
Total Costs	128,820	183,713	179,242	194,170	207,093	230,841
ESTIMATED MOLECULAR BIOSCIENCES PROGRAM INCOME						
Self-Support Tuition and Fees	0	99,407	198,815	265,086	298,222	342,403
Bridge Loan	133,820	84,306	0	0	0	0
PROGRAM REINVESTMENT AFTER EXPENSES AND INDIRECT						
Balance to re-investment	0	0	19,573	70,916	91,129	111,562

Program specific accreditation

Molecular Biosciences degrees are not common. At this point, the college does not have plans to seek program specific accreditation, as there is no appropriate accrediting body. If, at some point in the future, an appropriate program specific accreditation becomes an advantage for these programs and their graduates, the college will assess the potential benefits.

Pathway options beyond baccalaureate degree

Graduates of the Molecular Biosciences program who are interested in obtaining a graduate degree will have several local options. Northeastern University (Seattle campus) offers the following Master's in Science degrees, for which our students would be very well

prepared: MS in Biotechnology; MS in Health Informatics; MS in Regulatory Affairs in Food and Food Industries and MS in Regulatory Affairs for Drugs, Biologics and Medical Devices. We have started a dialogue with Dr. Paula Boyum, Associate Dean at Northeastern University (Seattle campus) to articulate potential pathways beyond a bachelor's degree for our graduates.
At the University of Washington there are also some very interesting options for our students, for instance: MS in Nutritional Sciences; Master's in Public Health (MPH in Genetics or in Epidemiology). High-achieving graduates, with a cumulative GPA higher than 3.0, could also apply to several PhD programs at UW (such as Biochemistry).
The Washington State University the Department of Molecular Biosciences offers an MS in Molecular Biosciences with discipline- specific options and a Professional Science Master's Degree (PSM). Representatives from Bellevue College are in the process of contacting faculty at UW and WSU so that when detailed curriculum has been developed, this conversation will progress to concrete discussion of pathways into graduate school for the BAS in MBS graduates.

Expert evaluation of program

Bellevue College has selected two experts to provide external review: Dr. Jason Kahn of the University of Maryland and Dr. William Davis of Washington State University. Their comments are included in Appendix II.

Dr. Jason D. Kahn is an Associate Professor in the Department of Chemistry and Biochemistry at the University of Maryland, College Park. He received an A.B. in Chemistry from Harvard and a PhD in Biophysical Chemistry from the University of California, Berkeley. He was a post-doctoral fellow at Yale University before starting at Maryland in 1994. He teaches undergraduate general chemistry, biochemistry, and molecular genetics classes and also graduate regulatory networks and nucleic acids classes. His research is on protein-nucleic acid interactions and nucleic acid structure and thermodynamics. His current focus is on the design of protein-DNA loops and the structure, function, stability, and topology of the products. He consults with textbook publishers and biotechnology companies.
Dr. William B. Davis is currently the Associate Dean at the College of Veterinary Medicine at Washington State University. Dr. William B. Davis (MS Chemistry, PhD Chemistry) is a Biochemist with more than 13 years of experience as an Associate Professor and Associate Director of Undergraduate Studies for programs in Biochemistry, Biotechnology, Genetics and Cell Biology, and Microbiology. In addition to departmental, university, and national recognition for his work in Academic Advising and Teaching, Dr. Davis was named in 2012 as one of the first 40 Leadership Fellows for PULSE (Partnership for Undergraduate Life Sciences Education). His current research focuses on DNA damage and repair in eukaryotic cells, undergraduate education in the classroom and in laboratories, and overcoming barriers to departmental and institutional transformation.

Appendix I: Course Descriptions

Core courses

Courses under development do not have a number designator so XX is used to indicate such.

PHYS& 114: General Physics (6 credits)

Basic principles of physics presented without use of calculus. Suitable for students majoring in technically oriented fields other than engineering or the physical sciences. Topics include kinematics, statics, forces and motion, energy, collisions, circular motion and rotational dynamics. Format includes lab work. Prerequisite: MATH&142 or equivalent.

Course outcomes

- State the equations for uniformly accelerated motion and solve problems involving these equations.
- Explain Newton's Laws of Motion and apply them to solve a variety of problems in mechanics.
- Use vector quantities to solve a variety of two-or three-dimensional problems such as dynamics problems involving Newton's second law or momentum.
- Define work, kinetic energy and potential energy and solve problems involving these quantities.
- Understand the nature and importance of conservation as a physical principle (conservation of energy, of mass, of mass-energy, and of linear momentum).
- Learn a set of angular-motion equations by analogy to the linear-motion equations previously studied and apply these equations to different scenarios.
- Use standard laboratory equipment to deepen understanding of physical concepts and relationships and communicate results including proper handling of uncertainty in data.

PHYS& 115: General Physics (6 credits)

Basic principles of physics presented without use of calculus. Suitable for students majoring in technically oriented fields other than engineering or the physical sciences. Topics include fluids, heat, thermodynamics, electricity, and magnetism. Format includes lab work. Prerequisite: PHYS& 114.

Course outcomes

- Understand and apply fluid dynamics concepts including density, pressure, flow, Archimedes' principle and Bernoulli's equation.
- Understand and apply thermodynamics concepts such as temperature, heat and heat capacity to a variety of problems including calorimetry and phase transitions.
- Describe the forces of gravity, electricity and magnetism using a vector field.
- Know how to use energy to solve problems with large gravitational masses, and electrostatic charges.
- Analyze the behavior of electrical circuits involving batteries, resistors and capacitors.
- Understand how magnetism and electricity are related including Ampere's law and Faraday's Law.
- Use standard laboratory equipment to deepen understanding of physical concepts and relationships and communicate results including proper handling of uncertainty in data.

CHEM&261: Organic Chemistry I (6 credits)

Topics include the study of acid-base theory, chemistry of alkanes, introduction to infrared spectroscopy, stereochemistry, nucleophilic substitution and elimination and radical reactions. Format includes lab work. Prerequisites: CHEM& 161 and CHEM& 162 and CHEM& 163.

Course outcomes

- Review of bonding theories including drawing Lewis structures and resonance structures, calculation of formal charges, describing atomic, molecular, and hybrid orbitals and using VESPR theory to predict bond angles, bond lengths, and polarity.
- Relate structure and acid base strength and predict acid base behavior based on pKa and solvent.
- Describe chemical and physical properties of alkanes, in particular the different types of isomers.
- Describe the basic concepts associated with infrared spectroscopy (IR) and identify major functional groups on the basis of IR spectra.
- Identify, name, separate, and determine total number of isomers for chiral compounds.
- Classify and rate reactions as Sn1, Sn2, E1, and E2 on the basis of substrate, solvent, nucleophile, and leaving group; provide detailed mechanisms for Sn1, Sn2, E1, and E2 reactions.
- Write general radical mechanisms, use radical terminology and explain thermodynamics of radicals.

CHEM& 262: Organic Chemistry II (6 credits)
Topics include the study of alkynes, radical reactions, NMR Spectroscopy, alcohols and ethers, conjugated unsaturated systems and aromatics. Format includes lab work. Prerequisite: CHEM& 261.

Course outcomes

- Name and list typical properties of ordinary alkenes, alkynes, alcohols and ethers.
- Devise synthetic pathway to produce Hoffman and Zaitsev alkenes, predict alkenes' basic reactions and write the corresponding mechanisms.
- Devise synthetic pathways to produce most alkynes, predict alkynes' basic reactions and write the corresponding mechanisms.
- Explain the principles of NMR spectroscopy and use these principles to deduce structures or predict NMR spectra of typical organic molecules.
- Devise synthetic pathways to produce most alcohols and ethers, predict their basic reactions and write the corresponding mechanisms.
- Identify, explain, and predict stability of conjugated systems.
- Summarize and explain the rules of resonance structures and apply resonance theory to explain thermodynamic and kinetic outcomes of appropriate reactions.
- Devise synthetic pathways for aromatic compounds, predict their basic reactions and write the corresponding mechanism.

CHEM& 263 Organic Chemistry III (6 credits)
Topics include the study of aldehydes and ketones, carboxylic acids and derivatives, dicarbonyls, amines, lipids, amino acids, proteins and nucleic acids. Format includes lab work. Prerequisite: CHEM& 262.

Course outcomes

- Name typical properties of aldehydes and ketones; list the differences in reactivity between them; devise synthetic pathways to produce them.

- Predict basic reactions of aldehydes, ketones, and alpha-carbons and write the corresponding mechanisms.
- Name typical properties of carboxylic acids, acid chlorides, acid anhydrides, esters, amides, nitriles and amines.
- Devise synthetic pathways for the compounds listed above; predict their basic reactions and write the corresponding mechanisms.
- Identify the major lipid families, giving properties of each.
- Show the differences between cationic, anionic, and zwitterionic forms of amino acids.
- Explain how proteins are sequenced; describe the four levels of protein structure and the intermolecular forces that determine them.
- Fully describe the chemical structure of DNA and RNA, drawing all possible DNA and RNA base pairs and the phosphate backbone.

CHEM 405: Biochemistry I (5 credits)
This is the first in a two-quarter biochemistry sequence. Topics include protein structure and function; carbohydrates and their metabolism, some of the major metabolic pathways and electron transport processes. Format includes lab work. Prerequisites: BIOL& 211 and CHEM& 261. Recommended: complete Organic Chemistry sequence.

Course outcomes
- Analyze the structure and properties of amino acids and of all four levels of protein structure.
- Discuss the relationship between structure and function (or misfunction) in proteins providing a wide variety of examples.
- Illustrate the principles involved in enzymatic catalysis, inhibition and kinetics from both an energetic and a structural standpoint, and apply those principles to a variety of problems.
- Examine the structure, chemical properties and function of relevant carbohydrates.
- Analyze metabolism in terms of high-energy compounds, nutrition and thermodynamics concepts.
- Examine glycolysis, glycogen metabolism, the citric acid cycle and the electron transport chain in full stepwise detail including reactions, enzymes and their regulation.
- Discuss organ specialization and regulation at the hormonal level of different metabolic pathways.
- Compare and contrast the sequence of reactions that take place during photosynthesis (for plants and cyanobacteria) with the electron transport chain.

CHEM 406: Biochemistry II (5 credits)
This is the second in a two-quarter biochemistry sequence. Topics include lipid structure, metabolism, transport and biosynthesis, nucleic acid structure, biosynthesis and function, DNA replication, transcription and translation. Format includes lab work. Prerequisites: CHEM 405.

Course outcomes
- Examine the chemical and physical properties of the biochemically relevant lipids and of the structures they can form (bilayers, micelles, etc.).
- Illustrate the composition, structure and properties of biological membranes.
- Examine different forms of signal transduction.
- Compare and ~~contrast the~~contrast the processes of fatty acid oxidation, fatty acid biosynthesis, cholesterol biosynthesis and lipid transport (in healthy and ill organisms).

- Explain the metabolic pathways involved in amino acid metabolism and protein degradation, including the role of ubiquitin and the proteasome.
- Illustrate the different catabolic pathways of purines and pyrimidines as well as of the ~~corresponding ribonucleotides~~corresponding ribonucleotides and deoxyribonucleotides.
- Compare and contrast DNA and RNA from the point of view of structure and function.
- Analyze the processes of DNA replication, damage and repair including relevant enzymes, chemical reactions and possible medical consequences.
- Discuss transcription, translation and control of gene expression in prokaryotic and eukaryotic cells.

DA 310: Introduction to Data Analytics (5 credits)
In this course, students will be introduced to the nature and importance of data management, data analysis and data representation and generalization, including the common statistical and technological tools and their applications in real world decision-making and research. Students will examine how data analysis technologies can be used to improve decision-making in business, administration, and policy as well as in the sciences, health care and education. This course emphasizes quantitative and technology based analysis of real world problems as well as report writing and presentation skills.
Prerequisite: MATH 130, 138 or MATH& 141 with a C or better, or entry code.

Course outcomes
- Identify the relationship between data analytics and business/scientific decision-making processes.
- Analyze and evaluate research methodologies.
- Identify the most common data analytics methods, and discuss how each method best applies to specific analytics questions.
- Identify the common technological tools used in data analytics: Excel, Minitab, S-Plus, SAS and R.
- Evaluate scientific/business problems and determine suitable analytical methods.
- Use technological tools such as Excel or R to manage data sets in various sizes and formats.
- Interpret results and clearly state the conclusion in reports and presentations with close attention to detail.

MBS 3XX[3]: Cell Biology (5 credits)
Exploration of cellular structure, organization, dynamics and signaling of diverse cell types including prokaryotic, plant and animal cells. Prerequisite: BIOL 275.

Course outcomes
- Examine the chemical and electrical properties of membranes.
- Illustrate transport across membranes; membrane budding and fission.
- Identify different types of receptors, ligands and signal transduction mechanisms.
- Explain different experimental methods used in imaging the cell structure and its dynamics.
- Describe the dynamic structure of microtubule motors, the microtubule and actin skeletons; understand the functioning of Brownian ratchets and spindle motors.
- Analyze the mechanics of mitotic chromosome segregation.
- Explain the principles of cell cycle control including graded and switch-like transitions, mitotic exit and DNA damage signaling.

[3] Courses under development don't have a course designator and XX is used for that.

- Illustrate frequency-mediated and paradoxical signaling with appropriate examples.

MBS 3XX: Genetics (5 credits)
Covers the principles of genetics in a variety of organisms incorporating its classical, molecular and biochemical aspects. Prerequisites: Cell Biology.

Course outcomes
- Discuss Mendelian and non-Mendelian inheritance including epistasis.
- Elaborate on the various types of mutations, their molecular nature and their effects.
- Describe the laboratory methods currently used in molecular biology techniques and their application in genetic analysis.
- Discuss the experimental use of mutagenesis and genetic screens including Genome Wide Association Studies.
- Describe the role of recombination in a variety of processes.
- Discuss the application of genome sequencing and other techniques to the treatment of diseases
- Examine the techniques used in quantitative genetic analysis.
- Discuss the application of genetic analysis on the population level.
- Elaborate on the ethical/social aspects of genome sequencing and genetic counseling.

MBS 3XX: Bioinformatics (5 credits); hybrid class
Topics include protein and DNA sequence alignments, evolutionary analysis and phylogenetic trees, obtaining protein secondary structure from sequence, and analysis of gene expression including clustering methods. Prerequisites: BIOL 275 and Cell Biology.

Course outcomes
- Access sequence data on appropriate databases for DNA, RNA and proteins.
- Explain and perform pairwise and multiple alignment methods.
- Understand and use BLAST proficiently (together with some more advanced related programs).
- Implement different practical strategies of multiple sequence alignment.
- Illustrate different computational strategies used to predict the 3D structure of new proteins.
- Explain the experimental techniques used in expressional and functional proteomics and the role of bioinformatics in analyzing the data.
- Perform motif and domain searches in protein databases.
- Explain microarray technology and microarray data analysis.

MBS 3XX: Molecular Biosciences Seminar
The Molecular Biosciences Seminar provides a forum to discuss original research articles published in the field. The instructor and the participants will choose the topics and the articles to be presented. Prerequisites: BIOL 275 and CHEM 275.

Course outcomes
- Compose a description of the research article in common language.
- Compile information about the various authors of the research article.
- Elaborate on the sources of funding for the research and their potential implications.
- Discuss the techniques used in generating the data and their application in other contexts.

- Decide whether the conclusions of the author are justified based on the results.
- Design questions to generate a class discussion and propose future directions for the research.
- Prepare and deliver a clear presentation about the research paper using appropriate software.

MBS 4XX: Advanced Methods in Molecular Biology (6 credits)
This course will train students in diverse methods in molecular biology analyzing structure/function relationships of macromolecules including DNA, RNA, proteins and lipids. Format includes lab work. Prerequisites: BIOL 275, Cell Biology and Genetics.

Course outcomes
- Elaborate on the flow of information between DNA, RNA and protein.
- Discuss the state-of-the-art techniques used in current research literature (including FACS and next-gen methods).
- Research and build protocols for molecular biology techniques.
- Evaluate (suitability and cost) various protocols and select the appropriate one.
- Design primers, DNA segments, plasmids and other constructs using appropriate software tools.
- Perform molecular biology techniques such as RNA isolation, RT-PCR, protein purification, Southern/Northern/ Western blots, etc.
- Generate site-directed mutations in DNA.
- Perform fluorescence microscopy in living and fixed cells.

MBS 4XX Practicum (10 credits)
The practicum is the culmination of the program where the student designs and completes an independent research project to demonstrate mastery of the curriculum in Molecular Biosciences. The project will be conducted in different laboratories in the Greater Seattle area. The location will be arranged by one of the program's instructors working together with the student and the BAS in MBS program manager. Students will be able to relate knowledge they acquired from courses to real-world settings and they will have a chance to reflect on their career goals and skills sets against the employer's job expectations.

The BAS in MBS program has the support of the members of the Advisory Board for the implementation of the practicum. The Advisory Board includes scientists and administrators from the Fred Hutchinson Cancer Research Center, the Allen Institute for Brain Science and Amgen (among others) so the BAS in MBS program developers are confident that there will be enough opportunities to set-up the practicum for all BAS in MBS students.

The BAS in MBS program developers will consult with the other programs at BC that have implemented a practicum to ensure that the projects planned and the mentorships involved are consistent with the desired outcomes. Bellevue College faculty and staff will continue to build partnerships with local prospective employers to increase the number of opportunities for the location of the practicum.
Prerequisites: completion of all core courses in the program.

Course outcomes
- Integrate skills and knowledge acquired from different courses.

- Demonstrate technical competency.
- Develop and implement a project plan following appropriate methods and tools.
- Develop and apply effective methods to manage project milestones and timeline.
- Present the results of the project using a high quality and appropriate format.
- Develop skill improvement plan based on capstone experience and self-assessment.

Elective courses

BTS 280: Project Planning, Tracking and Reporting (5 credits); online class
Introduces skills to gather information about responsibilities and resources required to accomplish tasks and calculate the overall cost to plan a project. Studies the software needed to create and modify a project plan. Projects combine software skills with project management principles to plan a project and keep it moving on track in the implementation phase. Recommended prerequisite: BTS 161.

Course outcomes
- Create a task-based schedule to outline the project scope.
- Manage resources and assignments to clearly communicate information.
- Track and analyze a project for progress reports and analysis.
- Identify required resources and budget.
- Communicate project information to integrate with other software platforms.
- Utilize intermediate to advanced software features to solve a business problem.
- Research resources to solve problems independently.

BIOL 312: Biology of Cancer (5 credits); hybrid class
Emphasis is on the cellular, genetic, biochemical and environmental aspects of the disease including discussion of the multiple disease nature of cancer, its diagnosis and treatment. Recommended prerequisite: BIOL& 160 or BIOL& 211.

Course outcomes
- Describe the basic biology and genetics of cells.
- Outline an overview of cancer (historical, epidemiological, chronic nature of the disease).
- Explain the cell cycle and its controls.
- Identify and describe cellular and genetic changes that occur in cancer.
- Discuss occupational, environmental and viral causes of cancer.
- Analyze the general process of angiogenesis and metastasis.
- List types of cancer; discuss their diagnosis and treatment.
- Describe the role of nutrition in cancer.
- Describe the societal, economic and ethical impacts of the fight against cancer.

MBS 4XX: Immunology (5 credits)
This course is an introduction to molecular immunology. Topics covered include an overview of the immune system, antibody and T-cell receptor structure and function, genes of the immunoglobulin family, cells and molecules that mediate the immune response, and medical applications of modern immunology. Prerequisites: CHEM 405 and CHEM 406.

Course outcomes

- Identify the components of the immune system.
- Illustrate in detail the structures of antibodies and T-cell receptors and the interaction between antigens and antibodies.
- Examine the role of major histocompatibility complex (MHC) molecules in immune responses.
- Explain T and B-cell activation by antigens and the generation of antibody and T-cell receptor diversity.
- Classify cell types, molecules and pathways by their innate and antibody-mediated effector functions.
- Explain the molecular and cellular interactions in inflammation.
- Discuss the innate and adaptive defense mechanisms against different microbes.
- Discuss the role of the immune response in health and disease.
- Examine current immunotherapeutic approaches.

MBS 4XX: Ethical conduct in research and biomedical industry (5 credits); hybrid class
This class introduces ethical problems relating to molecular biosciences research and biomedical industry. The emphasis is to train students on awareness of ethical issues specifically applicable to laboratory research and biomedical industry. Prerequisites: BIOL 275 ~~and~~and Molecular Biosciences Seminar.

Course outcomes

- Define ethics and scientific misconduct.
- Explain the importance of data management.
- Discuss issues about data falsification and fabrication.
- Discuss criteria for identifying plagiarism and conflict of interest.
- Elaborate on whistleblower laws and their importance.
- Apply course concepts to the analysis of current cases of ethical misconduct.

MBS 4XX: Introduction to Biomedical and Biotechnology Regulations (2 credits); online class
This course will provide basic knowledge of regulations that govern the biotechnology and biomedical industries. Focus is mainly on the regulatory environment in the United States.
Prerequisites: BIOL 275 and Molecular Biosciences Seminar.

Course outcomes

- Discuss the history of the establishment of the FDA and other regulatory agencies and important milestones in that history.
- Describe the principles of good manufacturing practices and quality assurance in the biotechnology/biomedical industry.
- Differentiate between primary types of medical products: drugs, biologics, and medical devices.
- Discuss the process and importance of clinical studies in medical product development.

MBS 4XX: Introduction to Patent Law (2 credits); hybrid class
This course introduces the requisites of patentability including eligible subject matter, utility, novelty and patent enforcement issues.

Course Outcomes

- Discuss the scope of Intellectual Property.
- Distinguish the different levels of protection between trade secrets versus registered trademark versus patent versus copyright.
- Explain the different parts of a patent application.
- Critically analyze patents or patent applications.
- Build a strategy for patent searching.
- Discuss and support arguments on whether an idea is novel or obvious.

BIOL& 241: Human Anatomy and Physiology (6 credits)
Introduces the structure and function of tissues, organs, and systems of the human body. Format includes laboratory work. Prerequisite: BIOL& 160 or BIOL& 211 with a C or better, or entry code.

BIOL& 242: Human Anatomy and Physiology (6 credits)
Continues the study of tissues, organs, and systems of the human body. Both BIOL& 241 and BIOL& 242 are needed for a complete study of the anatomy and physiology of all human systems. Format includes laboratory work. Prerequisite: BIOL& 241 with a C or better, or entry code.

Combined course outcomes for BIOL& 241 and 242
- Identify and describe subcellular and cellular structures, tissue types and their subcategories and the contribution of tissues to the structure and function of organs.
- Describe the structure and function of glands, major nerves, blood vessels and skeletal structures.
- Describe the position and function of each organ in the body.
- Describe the contribution of each system to the integrity of the whole organism, and explain abnormal conditions in terms of the system and/or primary organ disrupted.
- Using appropriate terminology explain the structural and functional aspects of nerve function.
- Describe the structure and function characteristics of the cardiovascular and circulatory system.
- Explain the dynamics of fluid, electrolyte, blood gas and nutrient distribution and exchange.

BIOL& 260: Microbiology (6 credits)
This course explores structure, function, and taxonomy of microbes, including bacteria and viruses, and their relationships to health and disease. Format includes substantial laboratory work and written reporting. Prerequisite: BIOL& 160 or BIOL& 211 with a C or better, or entry code.

Course outcomes
- Describe microbial genetics.
- Apply microbial genetics and genetic engineering to understanding biotechnology today.
- Describe sources of genetic variation: mutations, transposons, conjugation, transduction, etc.
- Compare prokaryotic and eukaryotic metabolism.
- List the elements and controls ~~of microbial~~of microbial nutrition, and growth and reproduction.
- Identify the pathogenic strategies used by microbes; describe phases and types of infection.
- Explain the importance of bacteria, viruses, protozoa, fungi, prions and viroids in causing infectious human diseases.
- Identify the strategies used to help a human host maintain a balance between health and disease.

- Demonstrate general laboratory techniques of an introductory microbiology lab (e.g. microscope use, staining, septic technique, etc.).

II: External Expert Reviews

Bellevue College received external reviews from two subject matter experts in higher education. Their complete comments are included below. The questions are presented in italics; W.D stands for Dr. William Davis; J.K. stands for Dr. Jason Kahn and BC stands for the Bellevue College representatives.

1) Do you have any general comments about the curriculum?

W.D.: The curriculum looks very good in my opinion.

J.K.: It is unusually well thought out and practical – many of these classes would be tremendously useful for our students at UMD and they generally don't have the opportunity to take them. I'm a chemist/biochemist, but even so the curriculum seems heavy on organic chemistry. There are so many other topics needed – do these students really need to know all about alkynes and dicarbonyls? I would rather see them take a separations or analytical chemistry course to learn about HPLC, affinity chromatography, ion exchange, centrifugation, etc.

BC: We currently only offer a three-course sequence in organic chemistry at BC. Students looking for a job in a pharmaceutical company definitely need all three courses. Students planning to work in a biotech company could probably get by with the material covered in the first and third courses, except that there is no logical way of avoiding the second course. We thought that in the future, if the program demonstrates enough growth we could design a two-course-sequence more appropriate for the strictly biotech orientation.
Regarding the second comment by Dr. Kahn, one of the prerequisites to enter the program is to take an Instrumental Analysis class (CHEM 275) that covers affinity chromatography, ion exchange, centrifugation and several other topics.

2) Are there any major elements missing?

W.D.: One class that I don't see, but perhaps it will be taken by students before applying, would be a Microbiology course. Students will get some exposure to microbiology if they take the elective Immunology course, but not deep immersion past Introductory Biology. Another area that is somewhat covered but might need to be strengthened is computer programing. It might be good to require a course in a common web programing language like Python or PERL. This would strengthen the bioinformatics educational content in the degree.

BC: Students in the Molecular Sciences Technician program (the two-year degree that precedes this BAS) can take Microbiology as an elective. We added this option to the BAS in MBS following your comment. Regarding the addition of computer programming, as the degree includes only one bioinformatics class, the current plan is to try to offer this class as an elective. The program developers have started a conversation with ~~BC's computer~~BC's computer science faculty to address this possibility.

J.K.: The curriculum is remarkably comprehensive. Consider adding organismal physiology, anatomy, and also pharmacology as electives, if they are available on campus. Three of the most important skills in biotech are cell culture, fermentation, and downstream purification. It would be useful to ensure that every student has some exposure to them.

BC: Students can take Anatomy and Physiology as electives in the Molecular Sciences Technician program. We added this option to the BAS in MBS following your suggestion. Cell culture, fermentation and purification are important skills in some biotech settings but not in others. The BAS in ~~MBS students~~MBS students learn a variety of purification methods in several classes. Unfortunately there is no plan to teach fermentation or cell culture in the program at this time. The decision was based on the rather large number of new classes and BC's current laboratory space. These are courses that faculty envisions including in the future of the program.

3) Are there any inconsistencies in the program?

W.D.: No major inconsistencies noted. The program has strong laboratory and curriculum content.

J.K.: There is some duplication among courses. There is nothing wrong with this as long as the instructors are aware of it and make sure to reinforce other courses rather than mindlessly repeat.

BC: There is some logical overlap of topics among a few of the courses. When the instructors plan the new cell biology and genetics courses, they will have to discuss with the instructors teaching Biochemistry I, II and Biology of Cancer where some topics will be primarily taught.

4) Have we included any unnecessary courses?

W.D.: No.

J.K.: See my answer to question #1.

5) At your current institution, would this curriculum prepare students to enter a specific Master's degree(s)? Please explain.

W.D.: Yes. Our program looks for courses such as Calculus, Statistics, Physics, Organic Chemistry, Biochemistry, and Genetics. All of these courses are covered in the proposed curriculum. Also, we look at GPA, and a 3.0 GPA to stay in this program should allow students to be competitive. In addition to our ~~masters~~master's degrees, these students might be eligible to apply for our PhD program in the Molecular Biosciences if they have a strong track record of independent research.

BC: We just want to note here that we have changed the average GPA requirement for graduation from 3.0 to 2.5, from comments and discussions with our external reviewers.

J.K.: I believe so. We have very few masters programs on campus, but these students would be well prepared to enter our biochemistry PhD program, with the exception that they would need physical chemistry or biophysical chemistry. This program could cover what is needed for most professional programs like pharmacy, optometry, or dental/medical school. They would certainly be prepared to go into MS in biotechnology programs.

6) *Do you think that the BAS in MBS graduates would be competitive when applying for a job or for entry to graduate school?*

W.D.: Yes. Their hands on training should make them competitive. They will want to be networked into the local community

J.K: Your students would be very well qualified, from a biochemical standpoint. Their solid training in data management, project management, and ethics will be valuable, because these attributes may not be taught as well on the job.

7) *Do you think there are clarifications needed in the proposal? If so, please explain.*

W.D.: None noted.

J.K.: I think there should be more clarity about how you will bring otherwise strong applicants with gaps up to speed and also how you will either assist or eject students who fall short of your standards. Also more discussion of how you will evaluate the performance of your graduates, i.e. programs to follow up with employers and generally get feedback on industry's perceptions of the program.

BC: BAS in MBS students will benefit from the student services described in pages 14-15 of this proposal, including (but not limited to) one-on-one and group tutoring. There will be at least one quarterly meeting between every student and the program manager or one of the faculty members of the program so that BC can keep track of how every student is doing. In case a student's GPA falls below the required 2.5 or a core course grade is below 2.0 the student will be encouraged to retake the course once to try to remediate the

situation. BC will monitor closely the performance of the students during the practicum and will constantly reassess how well the guidelines of that course are working for both students and employers. Upon graduation BC will conduct the type of monitoring described in Table VI.