

Biology/Biochemistry Major Curriculum Revision

Division of Natural Sciences and Mathematics

Submission to Academic Council

February 2011

Second Reading, March 2010

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Abstract and Proposed Resolutions

The biological sciences are moving at an unprecedented pace. This document presents the results of an extensive process, undertaken by the faculty of the NSM Division, to develop a curriculum that responds to the biology of today and the immediate future. The imperatives that drove us to embark on this process ranged from the *global*; a responsibility to prepare young scientists to deal with today's emerging health burdens and environmental challenges, to the *national*; a recognition that the US science base is declining at an unprecedented rate and that talented, well-prepared scientists are a limiting factor, to the *regional*; a desire to produce graduates who are able to serve, study and practice to resolve the particular challenges of the Pacific region, and to the *local*; where the mantra of 'think science, think Chaminade' needs to be backed with a distinctive, cutting-edge and innovative curriculum.

The Dean of NSM convened a Curriculum Committee to work on the revisioning of the biology major at Chaminade and the initiation of a biochemistry major. This committee reviewed multiple draft curriculum frameworks and endorsed a curriculum plan in their meeting of January 16th, 2011. This framework was presented at the NSM Divisional meeting of January 28th, 2011 and endorsed by the faculty of the Division at that time. Minutes of these meetings are available in the NSM office. The unanimous opinion of the committee (below), with the endorsement of the NSM Division, was to request that the Dean submit this framework to Academic Council for inclusion in the Fall, 2011 University Catalog.

Motion 1.

Create a new BS in Biochemistry degree and restructure the BS in biology degree into two tracks, 'Cellular and Molecular Biology' and 'Integrative and Organismal Biology', respectively. This to be effective FD2011.

Motion 2.

Remove the BA in Biology from the catalog effective FD2011.

Motion 3.

Remove PHY 151/151L and PHY 152/152L from the catalog effective FD2011.

Motion 4.

Remove the following 30 courses from the catalog effective FD2011: BI62/162L (general microbiology); BI 203/203L and 204/204L (cellular and organismic biology); BI 301 (comprehensive science review); BI 310 (evolutionary biology); BI 331/331L (advanced human nutrition); BI 431/431L (botany); BI 351/351L (comparative vertebrate anatomy); BI 352/352L (embryology); BI 353/353L (invertebrate zoology); BI 370/370L (cell and molecular biology); BI 395 (introduction to biomedical science); BI 431/431L (genetic biology); BI 442/442L (general and comparative physiology); BI 454/454L (histology); BI 460 (biostatistics); BI 490 (senior seminar); BI 480 (special topics), BI 362 (microbiology).

Responses to First Reading.

Note: amendments in light of first reading are highlighted using vertical lines in left margin. Responses to first reading are:

1. Revision of table on page 7 and in catalog descriptions;
2. Removal of several electives (Advanced Organic Chemistry, Ecotoxicology, Immunology, Integrative Physiology, Microbiology, Ecology);
3. Explanation of elective strategy (Section 1.4)
4. Re-casting of BI 362 Microbiology as “infection and Immunity”, removing the need for an immunology elective while preserving the coverage of microbiology and virology that is important for pre-med students;
5. Removal of proposed ‘Evolutionary Physiology’ new course and replacement with existing Ecology (BI 471) as required course for Integrative and Organismal BS in biology track;
6. Listing of FS 435 Applied Toxicology to establish a third ‘upper division outside the major’ course for biochemistry majors
7. Expansion of market analysis discussion to include data on graduate school placements.

Curriculum Committee Composition

Dr. Helen Turner (Chair)

Dr. Mike Dohm (Biology)

Dr. Joan Kuh (Biology)

Professor Ron Iwamoto (Biology)

Dr. Lee Goff (FS)

Dr. Joel Kawakami (Chemistry)

Dr. Bulent Terem (Chemistry)

Professor Janet Jensen (Chemistry and Pre-professional committee)

Ad hoc

- Subject specific experts (e.g. Dr. Lon White, Public health and epidemiology)
- Pre-professional committee members (P. Lee-Robinson, Lisa Perry)
- Support discipline members (physics, mathematics, CS)
- Other volunteer faculty

Curriculum Committee Mandate

- Centralize efforts towards a new biology and biochemistry curriculum
- Develop and implement timeline and guiding principles for pedagogy
- Solicit and represent wider faculty views during revision process
- Report upon revision process to wider faculty in their disciplines
- Prepare draft revision documents for faculty and then Academic Council approval
- Provide oversight and accountability for faculty efforts in development of course materials and assessment instruments

Part I: Specification of Learning Outcomes and Linkages

1. Description of the Proposed Majors.

1.1. The revised biology and new biochemistry majors at Chaminade

Biology Mission Statement.

Biology is the study of living organisms and is an increasingly dynamic and wide-ranging discipline. The mission of the Biology Major program at Chaminade is to deliver an excellent education in the biological sciences, preparing students to be innovative, rigorous and well-trained scientists, educators or health practitioners. The biology degree program recognizes that sophisticated intellectual content and practical experiences are central to the goal of equipping tomorrow's scientists. Students will be exposed to contemporary ideas in biology and challenging laboratory courses involving modern techniques and advanced instrumentation. Application of the scientific method, statistical and presentation skills, and critical evaluation of data are foundational to the course progression in the major, which can culminate in a capstone research experience. Reflecting the research interests and expertise of the faculty, our undergraduate students experience an education specifically targeting the areas of cell and molecular biology, signal transduction, genetics and genomics, and integrative biology. Undergraduate students are fully integrated in research activities and participate directly in the process of discovery. The curriculum is synthesized with a rich program of available development activities including internships, conference attendance and preparation activities for the health professions and graduate school.

Two degree programs are supported by the Biology discipline, the BS in Biology and the BS in Biochemistry. Two tracks are available within the BS in Biology, emphasizing Cellular and Molecular Biology and Integrative and Organismal Biology, respectively. The BS in Biochemistry is supervised collaboratively between the Biology and Chemistry faculty at Chaminade University. When selecting a major program, students should be aware that the individual curricula are tailored to specific preparation for post-graduate careers.

Biochemistry Mission Statement.

Biochemistry is the study of the living organism at the molecular level. It draws on techniques from a broad spectrum of specialized branches of chemistry to study the molecular basis of vital processes. The mission of the Biochemistry Major program at Chaminade is to deliver an excellent education in biological chemistry, preparing students to be innovative, rigorous and well-trained scientists, educators or health practitioners. The biochemistry degree program recognizes that chemistry is 'the central science' and that biochemical processes are essential to all life on our planet. The biochemistry major is composed of sophisticated intellectual content and practical experiences. Students will be exposed to contemporary ideas in biology, a challenging range of chemistry courses and rigorous laboratory courses involving modern techniques and advanced instrumentation. Application of the scientific method, statistical and presentation skills, and critical evaluation of data are foundational to the course progression in the major, which culminates in a capstone research experience. Our undergraduate students experience an education that reflects the research interests and expertise of the faculty, specifically targeting the areas of natural products, synthetic and computational chemistry, cell and molecular biology, signal transduction, genetics and genomics, and integrative biology. The curriculum is

synthesized with a rich program of available development activities including internships, conference attendance and preparation activities for the health professions and graduate school.

1.2. Congruence with mission

The vision of the Biology major is linked to key components of the Marianist educational experience. Our close-knit faculty fosters education in the family spirit, and the rapid progress in techniques and ideas that hallmarks biology drives our determination to prepare students who can adapt and change. Ultimately, the goal of science is to understand the mysteries of nature and improve the human condition, and so our program prepares students to serve society and promote justice.

The vision of the Biochemistry major is linked to key components of the Marianist educational experience. Our close-knit faculty fosters education in the family spirit, and the rapid progress in techniques and ideas that hallmark biology and chemistry drive our determination to prepare students who can adapt and change. Ultimately, the goal of science is to understand the mysteries of nature and improve the human condition, while recognizing the crucial hierarchy of all organisms within multi-level ecosystems. In particular, the goal of modern biochemistry is to develop novel molecules that address global problems, such as innovative therapies for disease, novel energy sources, and new biomaterials. Therefore, our program prepares graduate who will serve society and promote justice.

1.3. Degree overviews and four year plans

1.3.1. Summary Table.

The table below is presented to summarize the new and revised programs that will be in effect as of Fall 2011.

Degree Awarded	B.S. in Biochemistry	B.S. in Biology	
		Cell and Molecular Biology Track	Integrative and Organismal Biology Track
Key Features	CH 323 and CH 324 MA 210 and 211 PHY 251 and 252	CH 323 and CH 324 MA 210 and 211 PHY 251 and 252	CH 323 and CH 324 MA 210 PHY 251 and 252
Is there a research requirement?	One semester Second semester elective	One semester Second semester elective	Optional as one semester elective
Is there an internship requirement?	No but optional and recommended for pre-med	No but optional and recommended for pre-med	Yes, one semester
What are target post-graduate destinations for which this degree seeks to prepare students?	Health professions (MD, Pharm.D etc) Graduate School in Chemistry/Biochemistry Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc) Graduate School in Biology Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc) Graduate School in Biology Biotechnology Industry, Agencies Biology Education
Is this program suitable for students who seek to enter medical or other health professional schools?	Yes – and will be augmented by pre-med seminar series and other enrichment activities		

1.3.2. Four year plan: BS in Biology (Cellular and Molecular Track) (BI)

YR	Fall	Spring
1	Principles of Evolution and Ecology (1) Introduction to Laboratory Techniques (1) CUH100 (1) Cellular & Organismal Biology I – Cell biology (3) Cellular & Organismal Biology I L (1) EN101 (3) MA 110 (3) COM101 (3) PHILxxx (3) (19)	Digital Biology (1) (BI 190 Pre-Health/GS Seminar (1)) Cellular & Organismal Biology II – Organs/organisms (3) Cellular & Organismal Biology II L (1) EN102 (3) HISxxx (3) RE103, 205 or 211 (3) Social Science (3) (17-18)
2	Biotechniques I - DNA/RNA/Protein (1) Molecular Biology I – Genes & Genetics (3) Molecular Biology I L (1) CH 203/L (5) MA 210 (4) ENxxx English Literature (3) (17)	Biotechniques II - Advanced Instrumentation (1) Molecular Biology II – Genomics & Epigenetics (3) Molecular Biology II L (1) CH 204/L (5) Science Writing Seminar I – research proposal (1) MA 211 (4) Behavioral Science (3) (18)
3	Biostatistics (3) Developmental Biology I – patterning (3) Developmental Biology I Lab (1) CH 323 (4) CH 323L (1) Science Writing Seminar II - bioethics & conduct (1) Research I (3) Global Awareness (3) (19)	Epidemiology (3) Developmental Biology II – comparative anatomy (3) Developmental Biology II lab (1) CH 324 (4) CH 324L (1) Fine Art (3) Religion Upper Division (3) (18)
4	Physiology I –metabolism and nutrition (3) Physiology I Lab (1) PHY 251/L (5) Systems Biology (3) <u>Elective #1 (3-4)</u> From: BI 430 Infection and Immunity* BI 433 Molecular Evolution with Lab BC 360/L Biochemistry with Lab*[#] BI 499 Research II Upper division outside major (3) (19) <i>*Recommended electives for pre-med students</i> <i>[#]BC/CH/FS courses satisfy upper division outside major requirement</i>	Physiology II – neurophysiology (3) Physiology II Lab (1) PHY 252/L (4) <u>Elective #2 (3)</u> From: BI 435 Cancer Biology* CH 447 Pharmacology[#] FS 437 Applied Toxicology[#] Interdisciplinary (3) Upper Division outside major (3) (17)

1.3.3. Four year plan: BS in Biology (Integrative and Organismal Track) (BI)

YR	Fall	Spring
1	<p>Principles of Evolution and Ecology (1) Introduction to Laboratory Techniques (1) CUH100 (1) Cellular & Organismal Biology I - Cell biology (3) Cellular & Organismal Biology I L (1)</p> <p>EN101 (3) COM101 (3) PHILxxx (3) HISxxx (3)</p> <p>(19)</p>	<p>Digital Biology (1) (BI 190 Pre-Health/GS Seminar (1))</p> <p>Cellular & Organismal Biology II – Organs/organisms (3) Cellular & Organismal Biology II L (1)</p> <p>EN102 (3) MA 110 (3) Social Science (3) RE103, 205 or 211 (3)</p> <p>(17-18)</p>
2	<p>Biotechniques I - DNA/RNA/Protein (1) Molecular Biology I – Genes & Genetics (3) Molecular Biology I L (1) CH 203/L (5) MA 210 (4) ENxxx English Literature (3)</p> <p>(17)</p>	<p>Biotechniques II - Advanced Instrumentation (1) Molecular Biology II – Genomics & Epigenetics (3) Molecular Biology II L (1) Science Writing Seminar I - research proposal/paper (1) CH 204/L (5) Behavioral Science (3) Fine Art (3)</p> <p>(17)</p>
3	<p>Biostatistics (3) Developmental Biology I – patterning (3) Developmental Biology I Lab (1) Science Writing Seminar II – bioethics and conduct (1) CH 323/L (5) PHY 251/L (5) Internship (1)</p> <p>(19)</p>	<p>Epidemiology (3) Developmental Biology II – comparative anatomy (3) Developmental Biology II lab (1) CH 324/L (5) PHY 252/L (5)</p> <p>(17)</p>
4	<p>Physiology I –metabolism and nutrition (3) Physiology I Lab (1) Systems Biology (3) <u>Major Elective #1 (3-4)</u> From: BI 430 Infection and Immunity * BC 360 Biochemistry I with Lab[#] BI 433 Molecular Evolution with Lab BI 495 Research I Upper Division outside major (3) Global Awareness (3)</p> <p>(16-17) <i>*Recommended electives for pre-med students</i> <i>[#]BC/CH courses satisfy upper division outside major requirement</i></p>	<p>Physiology II – neurophysiology (3) Physiology II Lab (1) Ecology (3)</p> <p><u>Elective #2 (3)</u> From: BI 435 Cancer Biology* CH 447 Pharmacology*[#]</p> <p>Religion Upper Division (3) Interdisciplinary (3)</p> <p>(16)</p>

1.3.4. Four year plan: BS in Biochemistry (BC)

YR	Fall	Spring
1	Principles of Evolution and Ecology (1) Introduction to Laboratory Techniques (1) (BI 190 Pre-health/GS Seminar (1)) CUH100 (1) Cellular & Organismal Biology I - Cell biology (3) Cellular & Organismal Biology I L (1) BC 203 (4) BC 203L (1) EN101 (3) COM101 (3) (19)	Digital Biology (1) Cellular & Organismal Biology II – Organs/organisms (3) Cellular & Organismal Biology II L (1) BC 204 (3) BC 204L (2) EN102 (3) HISxxx (3) MA 110 (3) (19)
2	BC 323 Organic Chemistry I (4) BC 323L (1) Molecular Biology I – Genes & Genetics (3) Molecular Biology I L (1) MA 210 (4) ENxxx English Literature (3) RE103, 205, 211 (3) (19)	BC 324 Organic Chemistry II (4) BC 324L (1) BC 334 Analytical Chemistry (3) BC 334L Analytical Chemistry Lab (1) Molecular Biology II – Genomics & Epigenetics (3) Molecular Biology II L (1) MA 211 (4) Science Writing I – research proposal (1) (18)
3	BC 360 Biochemistry I (3) BC 360L Biochemistry I Lab (1) Physiology I –metabolism and nutrition (3) Physiology I Lab (1) PHY 251/L (5) Science writing II-bioethics and conduct (1) PHILxxx (3) (17)	BC 362 Biochemistry II (3) BC 362L Biochemistry II Lab (1) PHY 252/L (5) Research I (3) Upper division outside major (3) Behavioral Science (3) (18)
4	BC 420 Physical Chemistry (3) Systems Biology (3)[#] <u>Elective #1 (3-4)</u> From: CH 440 Natural Products Chemistry with Lab BI 320 Developmental Biology I with Lab CH 403 Inorganic Chemistry BI 430 Infection and Immunity * BI 499 Research II Religion Upper Division (3) Social Science (3) Upper division outside major (3) (18-19) <i>*Recommended electives for pre-med students</i>	BC 430L Instrumental Analysis Lab (2) <u>Elective #2 (3-4)</u> From: BI 411 Physiology II with Lab * BI 321 Developmental Biology II with Lab* CH 447 Pharmacology* BI 435 Cancer Biology* FS 435 Applied Toxicology (upper div. outside major) (3) Interdisciplinary (3) Fine Art (3) Global Awareness (3) (17-18)

1.4. Elective Courses.

In setting the number of elective courses the faculty seek to be efficient in terms of catalog expansion and scheduling, yet offer courses that will distinguish the programs described above. The tables below are presented as a guide to the electives that are planned.

Course	Title	Elective for	Semester
CH 440/L	Natural Products Chemistry with Lab	Biochemistry major	Fall (alternate years)
CH 403	Inorganic Chemistry	Biochemistry major	Fall (alternate years)
CH 447	Pharmacology	Biochemistry major	Spring (alternate years)
BI 430	Infection and Immunity	Biology major	Fall (alternate years)
BI 435	Cancer Biology	Biology major	Spring (alternate years)
BI 433/L	Molecular Evolution with Lab	Biology major	Fall (alternate years)

Required biology courses that can act as biochemistry major electives:

Course	Title	Elective for	Required for	Semester
BI 320/L	Developmental Biology I with Lab	Biochemistry major	Biology major	Fall
BI 321/L	Developmental Biology II with Lab	Biochemistry major	Biology major	Spring
BI 410/L	Physiology II with Lab	Biochemistry major	Biology major	Spring

Required biochemistry course that can act as biology elective:

Course	Title	Elective for	Required for	Semester
BC 360/L	Biochemistry I with Lab	Biology major	Biochemistry major	Fall

2. Program Learning Outcomes

2.1. Biology Program Learning Outcomes.

Upon completion of the B.S. degree program in Biology the student will demonstrate:

1. An understanding of the scientific method and the ability to design and test a hypothesis;
2. The ability to visualize, statistically evaluate, validate and interpret scientific data, and to communicate science effectively both orally and in writing;
3. The ability to acquire and comprehend information from published scientific literature and to employ computational resources in the resolution of biological problems;
4. An understanding of the chemical and physical principles that unite all life forms, and of biological organization at the molecular, cellular, tissue, organ, organism and system levels;
5. The ability to define the components and processes of genetic and epigenetic information transmission, and their determinant effects on the adaptive and evolutionary processes that they drive.
6. An understanding of the etiology of major human disease burdens in terms of pathophysiological mechanisms, epidemiology within populations and possible therapeutic approaches;
7. An understanding of the entry requirements, career pathways and progression for the major post-graduate fields of research, education and the health professions.

2.2. Biochemistry Program Learning Outcomes

Upon completion of the B.S. degree program in Biochemistry the student will demonstrate:

1. An understanding of the scientific method and the ability to design and test a hypothesis;
2. The ability to visualize, statistically evaluate, validate and interpret scientific data, and to communicate science effectively both orally and in writing;
3. The ability to acquire and comprehend information from published scientific literature and to employ computational resources in the resolution of biological and chemical problems;
4. An understanding of the chemical and physical principles that unite all life forms, and of biological organization at the molecular, genetic and epigenetic, cellular, tissue, organ, organism and system levels;
5. An understanding of the principles of organic, inorganic, analytical and physical chemistry, with particular relationship to the biochemical processes of living organisms;
6. An understanding of the linkage between perturbations in biochemical pathways and the etiology of human disease, and of the potential for chemistry and biochemistry to yield therapeutic approaches;
7. An understanding of the entry requirements, career pathways and progression for the major post-graduate fields of research, education and the health professions.

2.3. Core Curriculum linkages to the PLO

The Core Curriculum requirements have been linked to the revised BIOLOGY major Program Learning Outcomes as follows:

Core Curriculum	Course	Linkage to PLO in BIOLOGY Major						
		PLO#1	PLO#2	PLO#3	PLO#4	PLO#5	PLO#6	PLO#7
Basic Skills <ul style="list-style-type: none"> • Reading & Composition • Mathematical Literacy • Communications 	EN 101	I,D	I,D	I,D	I,D	I,D	I,D	I,D
	EN 102	D,M	D,M	D,M	D,M	D,M	D,M	D,M
	MA 110	I	I,D			I,D		
	COM 101	I,D	I,D	I,D	I,D	I,D		
Writing proficiency Competency in communication in writing to both professionals in their field and the public	EN 101	I,D	I,D	I,D	I,D	I,D	I,D	I,D
	EN 102	D,M	D,M	D,M	D,M	D,M	D,M	D,M
General Education <i>Seven fundamental fields of study: History, Literature, Fine arts, Social science, Behavioral science, Global awareness, Religion, Philosophy, Natural sciences.</i>		I,D		I,D, M			I,D, M	I,D, M
Interdisciplinary Courses Synthesis of learning		D,M	D,M	D,M	D,M	D,M	D,M	D,M

The Core Curriculum requirements have been linked to the revised BIOCHEMISTRY major Program Learning Outcomes as follows:

Core Curriculum	Course	Linkage to PLO in BIOLOGY Major						
		PLO#1	PLO#2	PLO#3	PLO#4	PLO#5	PLO#6	PLO#7
Basic Skills								
<ul style="list-style-type: none"> • Reading & Composition • Mathematical Literacy • Communications 	EN 101	I,D	I,D	I,D	I,D	I,D	I,D	I,D
	EN 102	D,M	D,M	D,M	D,M	D,M	D,M	D,M
	MA 110	I	I,D			I,D		
	COM 101	I,D	I,D	I,D	I,D	I,D		
Writing proficiency								
Competency in communication in writing to both professionals in their field and the public	EN 101	I,D	I,D	I,D	I,D	I,D	I,D	I,D
	EN 102	D,M	D,M	D,M	D,M	D,M	D,M	D,M
General Education								
Seven fundamental fields of study: History, Literature, Fine arts, Social science, Behavioral science, Global awareness, Religion, Philosophy, Natural sciences.		I,D		I,D, M			I,D, M	I,D, M
Interdisciplinary Courses		D,M	D,M	D,M	D,M	D,M	D,M	
Synthesis of learning								

2.4. Linkages between major courses and the PLO

Course	Linkage to PLO in BIOLOGY Major						
	PLO#1	PLO#2	PLO#3	PLO#4	PLO#5	PLO#6	PLO#7
<i>BI 099</i>	I	I	I				
<i>BI 100</i>	I	I	I	I	I	I	
<i>BI 104</i>	I	I	I				
<i>BI 190</i>							I,D
<i>BI 205</i>	I,D	I,D	I,D	I,D	I,D	I,D	
<i>BI 206</i>	I,D	I,D	I,D	I,D	I,D	I,D	
<i>BI 207</i>	I,D	I,D	I,D	I,D	I,D	I,D	
<i>BI 208</i>	I,D	I,D	I,D	I,D	I,D	I,D	
<i>BI 210L</i>	D	D	D				
<i>BI 211L</i>	D	D	D				
<i>BI 300</i>	D	D	D,M	D	D	D	D
<i>BI 302</i>	D	D	D,M	D	D	D	D
<i>BI 310</i>	D,M	D,M	D,M			D,M	
<i>BI 311</i>	D,M	D,M	D,M	D,M		D,M	
<i>BI 320</i>	D,M	D,M	D,M	D,M	D,M		
<i>BI 321</i>	D,M	D,M	D,M	D,M	D,M		
<i>BI 387</i>							D,M
<i>BI 410</i>	D,M	D,M	D,M	D,M		D,M	
<i>BI 411</i>	D,M	D,M	D,M	D,M		D,M	
<i>BI 420</i>				D,M	D,M	D,M	
<i>BI 430</i>			D,M	D,M	D,M	D,M	
<i>BI 433</i>			D,M	D,M	D,M	D,M	
<i>BI 435</i>			D,M	D,M	D,M	D,M	
<i>BI 437</i>			D,M	D,M	D,M	D,M	
<i>BI 439</i>			D,M	D,M	D,M	D,M	
<i>BI 471</i>			D,M	D,M	D,M	D,M	
<i>BI 495</i>	D,M	D,M	D,M	D,M	D,M	D,M	D,M
<i>BI 496</i>			D,M	D,M	D,M	D,M	
<i>BI 499</i>	M	M	D,M	D,M	D,M	D,M	D,M

Course	Linkage to PLO in BIOCHEMISTRY Major						
	PLO#1	PLO#2	PLO#3	PLO#4	PLO#5	PLO#6	PLO#7
<i>BI 099</i>	I	I	I				
<i>BI 100</i>	I	I	I	I	I	I	
<i>BI 104</i>	I	I	I				
<i>BI 190</i>							I,D
<i>BI 205</i>	I,D	I,D	I,D	I,D	I	I,D	
<i>BI 206</i>	I,D	I,D	I,D	I,D	I	I,D	
<i>BI 207</i>	I,D	I,D	I,D	I,D		I,D	
<i>BI 208</i>	I,D	I,D	I,D	I,D		I,D	
<i>BI 300</i>	D	D	D,M	D	D	D	D
<i>BI 302</i>	D	D	D,M	D	D	D	D
<i>BI 310</i>	D,M	D,M	D,M			D,M	
<i>BI 311</i>	D,M	D,M	D,M	D,M		D,M	
<i>BI 320</i>	D,M	D,M	D,M	D,M			
<i>BI 321</i>	D,M	D,M	D,M	D,M			
<i>BI 362</i>			D,M	D,M	D	D,M	
<i>BI 387</i>							D,M
<i>BI 410</i>	D,M	D,M	D,M	D,M		D,M	
<i>BI 411</i>	D,M	D,M	D,M	D,M		D,M	
<i>BI 420</i>				D,M		D,M	
<i>BI 430</i>			D,M	D,M	D	D,M	
<i>BI 433</i>			D,M	D,M	D	D,M	
<i>BI 435</i>			D,M	D,M	D	D,M	
<i>BI 437</i>			D,M	D,M	D	D,M	
<i>BI 471</i>			D,M	D,M	D	D,M	
<i>BI 495</i>	D,M	D,M	D,M	D,M		D,M	D,M
<i>BI 496</i>			D,M	D,M	D,M	D,M	
<i>BI 499</i>	M	M	D,M	D,M	D,M	D,M	D,M
<i>BC 203</i>	I,D	I,D	I,D	I,D	I,D	I,D	
<i>BC 204</i>	I,D	I,D	I,D	I,D	I,D	I,D	
<i>BC 323</i>	D,M	D,M	D,M	D,M	D,M	D,M	
<i>BC 324</i>	D,M	D,M	D,M	D,M	D,M	D,M	
<i>BC 334</i>	D,M	D,M	D,M	D,M	D,M	D,M	
<i>BC 360</i>	D,M	D,M	D,M	D,M	D,M	D,M	
<i>BC 362</i>	D,M	D,M	D,M	D,M	M	D,M	
<i>BC 420</i>	D,M	D,M	D,M	D,M	M	D,M	

<i>BC 430L</i>	D,M	M	M				
<i>CH 440</i>	D,M	D,M	D,M	M	M	D,M	
<i>CH 447</i>	D,M	D,M	D,M	M	M	D,M	
<i>CH 490</i>		M	M				D,M

Part II: Other Elements to be included in the presentation of a major.

3. Market Analysis

The biochemistry major, and the CMB track of the BS in biology, is primarily targeted at students who intend to enter health professions or graduate school. The biochemistry BS is a particularly attractive degree for medical school admissions boards, and there are elements of these new programs that have been specifically designed with the pre-med market in mind. This is an extensive market, with over 200,000 students in the US seeking 18,000 medical school placements in 2009. The AMA has recommended increasing the number of medical school places in the US by 15% to deal with the physician shortage, which JAMA places, at 85,000 to 200,000 deficit by 2020. In Hawaii, especially the outer islands the physician shortage defined by a JABSOM study in 2010 is striking, and even worse in the Pacific islands.

Other markets for our graduates include research doctorates or MS degrees in the fields of school in biology, biochemistry, and pharmacology. The U.S awards 10,000 MS degrees per year in the life sciences, and 7,000 PhDs. Professional doctorates such as the PharmD will also be well-served by our curriculum. Our graduates will be well prepared for entry-level, and above, positions in the biotechnology and biomedicine sector in Hawaii and on the US mainland. Private, Federal and academic research laboratories employ 480,000 individuals. The CMB and IO tracks will be of particular interest to students who seek jobs in State and Federal agencies concerned with areas such as public health, and the IO track would prepare students for agency destinations in ecology and conservation biology as well as the growing 'natural laboratory' studies that characterize Hawaii science outside the biomedical arena.

These curricula have distinguishing features. There are few undergraduate curricula that embrace areas such as systems biology, digital biology, immunology, natural products chemistry and molecular evolution. We will be viewed as cutting-edge because of this course content. The prevalence of two-semester course sequences adds great depth, for the first time allowing topics such as molecular biology to be approached in appropriate depth at Chaminade.

The curriculum is designed to be highly supportive of student success. There are elements of the curriculum that have been specifically designed by faculty to address problem areas that have emerged as areas of concern for our current students. The strong commitment to lab skills preparation addresses the fact that faculty are currently finding students emerging from 200-level core courses with poor retention of skills in the areas of solution preparation, liquid handling and other critical laboratory techniques. The Introduction to Laboratory Techniques course is part of the solution to this problem, combined with a renewed commitment to embed good practical skills in each lab course taught in NSM. The inability of many of our senior students to write about science in anything other than a colloquial 'magazine article' style is troubling, and the two semester 'Science Writing' sequence aims to help address this, again with a renewed commitment by the faculty to embed writing assignments throughout the four year program. Moreover, this sequence will also cover areas of scientific ethics and conduct, which are not intentionally addressed in our current programs. Taken together, these distinctive new curricula will prepare a highly competitive graduate for a variety of post-graduate destinations in Hawaii and beyond. As we enter a new era of delivering on our promise of a cutting-edge

science education at Chaminade, it is reasonable to expect that our market share will grow and we will become a destination of choice for Hawaii students.

Internally, we believe that the biochemistry degree may split the FS enrollment slightly, because we have a small but consistent number of FS students who are intending to apply to medical school but take the FS degree at Chaminade because it is 'more rigorous' than the current biology offerings. This is problematic because medical school admissions committees do not typically look well upon the FS degree, since few FS programs nationally have the biology and chemistry content that hallmarks ours. The table below presents the enrollment goals that we have for the programs described here over the period 2011-2015.

Incoming freshmen	2010 baseline	2011	2012	2013	2014	2015
Biology*	52	35	40	40	43	45
Biochemistry*	0	25	30	30	32	35
subtotal	52	60	70	70	75	80
Computer Science***	14	+50%	+25%	+25%	+10%	36
Forensic Science	58	+10%**	stable	stable	stable	64
Nursing	72	72	72	72	72	72
					total	252

**Note we would expect both Biology and Biochemistry to have pre-med students*

*** slight increase due to projected accreditation in Spring 2011, but we predict that the popularity of the major has plateaued overall*

**** growth assumed due to new curriculum and enhanced facilities*

4. Sources used in designing the program

- Source documents from
 - American Association of Medical Colleges
 - American Association of Public Health
 - Liberals Arts Education in the Sciences Program
 - Howard Hughes Medical Institute
 - National Center for Science Education
 - National Science Foundation
- Review of a wide-range of curricula from Universities across the spectrum including liberal arts, comprehensive, research-intensive, private and public schools
- "Rising Above the Gathering Storm" report to the U.S. Congress by the AAS, and IOM.
- "Good to Great" by Jim Collins
- Internal and external discussion, including contributions from Dr. Michael Gaines, INBRE program advisors, EPSCOR program advisors, Dr. Bruce Stevenson, Dr. Steven Robinow, Lon White, MD., and alumni of the current programs who are at graduate or medical school.

5. Consistency of program with institution-wide objectives

Each question addressed below is contained within the narrative of the 'Procedures for Proposing a New Program to Academic Council' document, taken from the CUH intranet in 2009.

<i>How early in the program is a course in the major offered?</i>	Within the first year
<i>Is a cohort for incoming students in this major appropriate?</i>	Yes – a cohort would be required
<i>As appropriate to the character of the major, how do the curricular and co-curricular elements assist a student with understanding expectations of employers/graduate schools and assist them with initiating/pursuing their career?</i>	Real-world experience in professional settings are embedded in the curriculum as the capstone experience; co-curricular activities will include internships, research placements
<i>Does the major include internship possibilities?</i>	Yes
<i>Does the major include a capstone course? What are the major-specific qualities of the internship or capstone course?</i>	Yes, the required capstone will be a research or professional shadowing internship culminating in a peer-reviewed presentation. These experiences will be performed in locations that are unique to the biology and biochemistry majors, including (a) research laboratories at Chaminade and beyond, (b) local or national biotechnology or pharmaceutical companies, (c) health professional settings including MD/DO practices.
<i>How "efficient" is the structure of the major? That is, to what extent does it draw upon existing courses? What is the number of electives in the curriculum? Is the number of students proportionate to the number of electives?</i>	See curriculum grid above, section 1.3.
<i>Which courses in the curriculum are suitable to be taught using service learning?</i>	Several, including marine biology general education, epidemiology, cancer biology
<i>Which courses in the curriculum are suitable to be taught on-line?</i>	Some GE requirements outside of NSM, none of the major-specific offerings are planned to be online at this time.

6. Will this program affect other programs?

The general education science offerings in biology and chemistry remain unchanged. The nursing biology (Anatomy and Physiology, Clinical Nutrition and Genetic and Genomics) remains unchanged. Effects on other programs are summarized as follows:

1. Physics will no longer be required to offer PHY 151/152 and their respective laboratories;
2. Mathematics may no longer offer MA 331 as frequently, due to the lack of this requirement for biology majors. FS and CS majors will still need this class.

3. FS majors who previously took biology classes from the old catalogs will be accommodated with the following equivalencies, and the FS catalog entry will be modified to alter pre-requisites for new students.

OLD		NEW
BI 162/162L	general microbiology	Any 100 level biology
BI 203/203L	cellular and organismic biology	BI 205/L
BI 204/204L	cellular and organismic biology	BI 206/L
BI 301	comprehensive science review	BI 300, BI 302, BI 496
BI 310	evolutionary biology	BI 433
BI 331/331L	advanced human nutrition	BI 410/L
BI 431/431L	botany	Any 400 level elective
BI 351/351L	comparative vertebrate anatomy	BI 321/L
BI 352/352L:	embryology	BI 320/L
BI 353/353L	invertebrate zoology	BI 363/L or BI 439/L
BI 370/370L	cell and molecular biology	BI 208/L
BI 395	introduction to biomedical science	BI 300, BI 302, BI 496, BI 390
BI 431/431L	genetic biology	BI 208/L or BI 433
BI 442/442L	general and comparative physiology	BI 41/L, BI 411/L, BI 439/L
BI 454/454L	histology	Any 400 level elective
BI 460	biostatistics	BI 310
BI 490	senior seminar	BI 300, BI 302, BI 496, BI 390
BI 480	special topics	BI 300, BI 302, BI 496, BI 390

CREDIT COUNT Comparison with FS

Pre-major	FS=56	BC=61
Major	FS=37	BC=29
Elective FS=9		BC=6-8

102	96-98
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7. Catalog descriptions

7.1. Biology

Biology Program

Program Advisors: Dr. Jolene Cogbill, Dr. Michael Dohm, Dr. Joan Kuh, Ms Lisa Perry, Mr. Ron Iwamoto, Dr. Helen Turner

Pre-health advisors: Ms Patricia Lee-Robinson; Ms Lisa Perry, Ms Janet Jensen.

Biology Mission Statement

Biology is the study of living organisms and is an increasingly dynamic and wide-ranging discipline. The mission of the Biology Major program at Chaminade is to deliver an excellent education in the biological sciences, preparing students to be innovative, rigorous and well-trained scientists, educators or health practitioners. The biology degree program recognizes that sophisticated intellectual content and practical experiences are central to the goal of equipping tomorrow's scientists. Students will be exposed to contemporary ideas in biology and challenging laboratory courses involving modern techniques and advanced instrumentation. Application of the scientific method, statistical and presentation skills, and critical evaluation of data are foundational to the course progression in the major, which can culminate in a capstone research experience. Reflecting the research interests and expertise of the faculty, our undergraduate students experience an education specifically targeting the areas of cell and molecular biology, signal transduction, genetics and genomics, and integrative biology. Undergraduate students are fully integrated in research activities and participate directly in the process of discovery. The curriculum is synthesized with a rich program of available development activities including internships, conference attendance and preparation activities for the health professions and graduate school.

The vision of the Biology major is linked to key components of the Chaminade educational experience. Our close-knit faculty fosters education in the family spirit, and the rapid progress in techniques and ideas that hallmarks biology drives our determination to prepare students who can adapt and change. Ultimately, the goal of science is to understand the mysteries of nature and improve the human condition, and so our program prepares students to serve society and promote justice.

Biology Program Learning Outcomes.

Upon completion of the B.S. degree program in Biology the student will demonstrate:

1. An understanding of the scientific method and the ability to design and test a hypothesis;
2. The ability to visualize, statistically evaluate, validate and interpret scientific data, and to communicate science effectively both orally and in writing;
3. The ability to acquire and comprehend information from published scientific literature and to employ computational resources in the resolution of biological problems;
4. An understanding of the chemical and physical principles that unite all life forms, and of biological organization at the molecular, cellular, tissue, organ, organism and system levels;

5. The ability to define the components and processes of genetic and epigenetic information transmission, and their determinant effects on the adaptive and evolutionary processes that they drive.
6. An understanding of the etiology of major human disease burdens in terms of pathophysiological mechanisms, epidemiology within populations and possible therapeutic approaches;
7. An understanding of the entry requirements, career pathways and progression for the major post-graduate fields of research, education and the health professions.

Biology Program Features:

The biochemistry program is supervised collaboratively between the Biology and Chemistry faculty at Chaminade University. Two degree programs are supported by the Biology discipline, the BS in Biology and the BS in Biochemistry. Two tracks are available within the BS in Biology, emphasizing Cellular and Molecular Biology and Integrative and Organismal Biology, respectively. The BS in Biochemistry is supervised collaboratively between the Biology and Chemistry faculty at Chaminade University. When selecting a major program, students should be aware that the individual curricula are tailored to specific post-graduate preparation for careers. These are outlined in the table below.

Degree Awarded	B.S. in Biochemistry	B.S. in Biology	
		Cell and Molecular Biology Track	Integrative and Organismal Biology Track
Is there an undergraduate research requirement?	One semester Second semester elective	One semester Second semester elective	Optional as one semester elective
Is there an internship requirement?	Optional*	Optional *	Yes
What are the target post-graduate destinations for which this degree is designed?	Health professions (MD, Pharm.D etc) Graduate School in Chemistry/Biochemistry/Bio medical Sciences/Pharmacology Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc) Graduate School in Biological/Biomedical Sciences Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc) Graduate School in Biology Biotechnology Industry State and Federal Agencies
Is this program suitable for students who seek to enter medical or other health professional schools?	Yes – specifically pre-med seminar series, other enrichment activities and candidacy for Medical and other health professions Early Admissions Program. <i>*students who intend to apply for medical, dental, veterinary or other professional schools are encouraged to use internships to complete a professional shadowing experience.</i>		

Within the BS programs in biology and biochemistry, it is possible to elect the 'pre-med' area of emphasis. Here, students are enrolled in a seminar series and other activities that specifically prepare for standardized tests such as MCAT, and for entry into professional areas such as medicine, dentistry, pharmacy, physical therapy and others. In addition, this election admits the student to candidacy for the Chaminade Medical School Early Admissions Program. Here students may be guaranteed seats at medical schools including Western University College of Osteopathic Medicine, A.T. Stills College of Medicine and Boston University School of Medicine, following the successful completion of a specific course of study at Chaminade. Interested students should contact a pre-health advisor at their earliest opportunity to discuss this program.

Degree Requirements.

For BS in Biochemistry see Biochemistry Major description.

BS in Biology Major Requirements:

Cellular and Molecular Track

Pre-major: BI 099, BI 100, BI 104, BI 205, BI 205L, BI 206, BI 206L, BI 207, BI 207L, BI 208, BI 208L, BI 201L, BI 211L, CH 203, CH 203L, CH 204, CH 204L, CH 323, CH 323L, CH 324, CH 324L, PHY 251, PHY 251L, PHY 252, PHY 252L, MA 210, MA 211.

Major: BI 300, BI 302, BI 311, BI 312, BI 320, BI 320L, BI 321, BI 3121L, BI 410, BI 410L, BI 411, BI 411L, BI 420, BI 495 and two upper division electives chosen from: BI 430, BI 433/L, BC 360/L, CH 447, BI 4357, FS 437, BI 499.

Integrative and Organismal Biology Track

Pre-major: BI 099, BI 100, BI 104, BI 205, BI 205L, BI 206, BI 206L, BI 207, BI 207L, BI 208, BI 208L, BI 201L, BI 211L, CH 203, CH 203L, CH 204, CH 204L, CH 323, CH 323L, CH 324, CH 324L, PHY 251, PHY 251L, PHY 252, PHY 252L, MA 210.

Major: BI 300, BI 302, BI 311, BI 312, BI 320, BI 320L, BI 321, BI 3121L, BI 387, BI 410, BI 410L, BI 411, BI 411L, BI 420, BI 471 and two upper division electives chosen from: BI 430, BI 433/L, BC 360/L, BI 435, CH 447, BI 495.

Pre-medical area of emphasis. Students who intend post-graduate studies at medical, dental, pharmacy or other health professional schools ('pre-med' students) are recommended to prepare with the BS in Biochemistry or BS in Cellular and Molecular Biology track. Pre-medical students are required to take BI 190 and other seminar courses recommended by faculty as part of the pre-medical preparation program. In addition, pre-medical students are recommended to use BI 387 internships (may be repeated for credit) in order to perform professional shadowing.

Biology Minor Requirements:

Minor: 12 semester hours of upper division biology including either BI 321/L or BI 410/L and two other lecture/laboratory courses.

Course Descriptions.

General Education Courses in Biology.

BI 101, BI 102 General Biology (3)

Overview of basic biological principles, human concerns of overpopulation, environmental pollution, genetic engineering. *Recommended for non-majors. BI 101 is not a prerequisite for BI 102. BI 101 and BI 102 offered annually. Concurrent registration in BI 101L and BI 102L necessary for lab science credit.*

BI 101L, BI 102L General Biology Lab (1)

One three-hour laboratory period per week to accompany BI 101 and BI 102. Laboratory work and field trips related to lecture topics. *BI 101L and BI 102L offered annually.*

BI 110 People and Nature (3)

Addresses biological, ecological and public health questions which may have social, ethical, religious, or political implications. *Recommended for non-majors. Offered annually. Concurrent registration in BI 110L required for lab science credit.*

BI 110L People and Nature Laboratory (1)

One three-hour laboratory period per week to accompany BI 110. Laboratory work such as testing for water quality, field trips to aquaculture farms, estuaries, and the like. *Offered annually.*

BI 103 Botany (3) with Laboratory (1)

Distribution, identification, structure, use and physiology of plants with special attention to plants of Hawaii. *AEOP program only. Recommended for non-science majors. Concurrent registration in BI 103L necessary for lab science credit.*

BI 115 Introduction to Marine Biology (3)

Life in various marine habitats studied with regard to its relationship to the ocean and to man. Various zones in the ocean and its inhabitants, the impact of man on the marine environment, and food sources from the sea will be discussed. *Recommended for non-science majors. Concurrent registration in BI 115L necessary for lab science credit.*

BI 115L Introduction to Marine Biology Laboratory (1)

One three-hour laboratory period per week to accompany BI 115. Classification, anatomy, and physiology of live and preserved marine animals. Field trips are included.

BI 130 Ethnobotany (3)

Common native and introduced flora of Hawaii are investigated. Endangered and threatened species, identification, communities and uses are stressed. *AEOP program only. Recommended for non-science majors. Concurrent registration in BI 130L required for lab science credit.*

BI 130 Ethnobotany Laboratory (1)

One three-hour laboratory period per week to accompany BI 130. Field trips and nature walks are included. *AEOP program only. Recommended for non-science majors.*

BI 131 Human Nutrition (3)

An introduction to basic concepts and current research in nutrition. The nature and roles of nutrients, nutrient requirements throughout the human life cycle, diseases resulting from over and under nutrition, food safety, and food sources. *Recommended for non-majors. Offered annually. Concurrent registration in BI 131L necessary for lab science credit.*

BI 131L Human Nutrition Laboratory (1)

One three-hour laboratory period per week to accompany BI 131. Survey of methodology and instrumentation involved in the analysis and evaluation of foods, their nutritional value, and diets. *Offered annually.*

BI 151-BI 152 Human Anatomy and Physiology (3-3)

Structure and function of the human body, to include basic biochemistry, cells, tissues, and a detailed and comprehensive study of the integumentary, skeletal, muscular, circulatory, immune, and digestive systems, and metabolism. Organ systems will include the nervous, urinary, endocrine, respiratory, and reproductive systems. *Required course for nursing majors. Prerequisites: BI 151 for BI 152. Concurrent registration in BI 151L-152L required.*

BI 151L-BI 152L Human Anatomy and Physiology Laboratory (1-1)

Laboratory to accompany BI 151-152. One three-hour laboratory per week will include examination of models and slides, dissection, and physiological exercises. *Prerequisites: BI 151L for BI 152L. Concurrent registration in BI 151-152 required.*

Core and Upper Division Courses In Biology:

BI 099 Introduction to laboratory techniques (1)

This course is an introduction to laboratory safety, and basic laboratory practice including liquid manipulations, calculations and correct usage of small instrumentation. Compulsory course for all students intending a biology or biochemistry major. *Six week course, one hour per week. Pass/fail.*

BI 100 Principles of evolution and ecology (1)

Biology is the study of diverse forms and processes of life. Emphasis on how evolutionary studies relate to broader understanding of conservation, ecology, genetics, and human biology. Survey of the applications of evolutionary and ecological theory to our understanding of the unity and diversity of life on earth.

BI 104 Digital Biology (1)

Biological and biomedical inquiry is increasingly dependent on computers. Survey of the role of text mining and biological databases, bioinformatics, modeling, and visualization of biological data in investigations of biological phenomena.

BI 190 Pre-health and professional sciences seminar I (1)

Introduction to the course of study and preparations necessary for making application to schools of medicine or schools of other health professions or graduate schools. The course will include an overview of the entrance requirements for such schools. Coursework will include experiences preparing for standardized examinations, resume writing and co-curricular enrichment activities.

BI 205 Cellular and Organismal Biology I – Cellular Biology

Introduction to the cell biology of prokaryotic and eukaryotic organisms, with particular reference to the relationships between structure and functions. Cell cycle and mitosis. Organization of cells, roles of cell signaling and extracellular environment in establishing structures in animals and plants. *Concurrent registration in BI 099, BI 103.*

BI 205L Cellular and Organismal Biology I Laboratory – Cellular Biology

Laboratory section accompanying BI 205. *Concurrent registration in BI 099 and BI 100 required.*

BI 206 Cellular and Organismal Biology II – Organs and Organisms

Introduction to animal and plant diversity, with emphasis on form and function, mechanisms of regulation in biological systems, and how organisms exchange materials and energy with their environment. *Prerequisites: BI 099, BI 103, BI 205.*

BI 206L Cellular and Organismal Biology II Laboratory – Organs and Organisms

Laboratory section accompanying BI 206. *Concurrent registration in BI 206 required. Prerequisites: BI 099, BI 100, BI 205.*

BI 207 Molecular Biology I– Genes and Genetics

Life cycles and meiosis. Mendelian inheritance. Population genetics. Chromosomal and molecular basis of inheritance. Flow of genetic information. Determining structure and function of genes. Mutation and DNA repair systems. Genetic basis of disease. DNA technology. *Prerequisites: BI 206/L.*

BI 207L Molecular Biology I Laboratory – Genes and Genetics

Laboratory section accompanying BI 207. *Concurrent registration in BI 207 required. Prerequisites: BI 206/L.*

BI 208 Molecular Biology II– Genomics and Epigenomics

Components and architecture of genomes. Linkage, physical mapping, and DNA sequencing. Comparing genomes of different species. Role of gene expression and gene networks in differentiation and morphogenesis. Role of DNA methylation and chromatin remodeling in regulation of genes. Role of regulatory RNAs in gene expression. *Prerequisites: BI 207/L. Materials intensive fee applies.*

BI 208L Molecular Biology II Laboratory – Genomics and Epigenomics

Laboratory section accompanying BI 208. *Concurrent registration in BI 208 required. Prerequisites: BI 207/L. Materials intensive fee applies.*

BI 210L Biotechniques Laboratory I – DNA/RNA/Protein (2)

Introduction to biological techniques. Techniques used in the fields of molecular and cellular biology are covered, including DNA, RNA and Protein purification and manipulation. One three-hour period per week. *Offered annually. Prerequisites: BI 099, BI 100, BI 206/L. Materials intensive fee applies.*

BI 211L Biotechniques Laboratory II – Advanced Instrumentation (2)

Practical introduction to instruments used in biological research, including advanced separation, microscopy and molecular biology, and bioassays. One three-hour period per week. *Offered annually.*
Prerequisites: BI 210. Materials intensive fee applies.

BI 300 Science Writing Seminar I – research proposal and publications (1)

Intensive introduction to science writing. Overview of the purpose and process of scientific publications, peer review and criteria for inclusion in the literature. Students will focus upon the development of written arguments, discussion of data and interpretation/analysis. Course will culminate in production and review of a grant proposal. *Prerequisites: BI 206/L, EN 102.*

BI 302 Science Writing Seminar II – bioethics and conduct (1)

Continuation of BI 300. Students will focus upon contemporary issues in science including funding policies, ethics and conduct of research. Course will culminate in writing of an authoritative review paper on an issue of interest selected by the student. *Prerequisites: BI 300.*

BI 304 Clinical Nutrition (3)

Nursing required course. Study of nutrients and their respective functions, food sources, and physiological needs. Dietary guidance and nutritional requirements through the lifespan are explored. Role of nutrition in prevention of, and intervention in, chronic diseases. *Prerequisites: BI 152/152L, CH 254/L, NUR 202, NUR 203.*

BI 305 Genetics and Genomics (3)

Nursing required course. Basic concepts in genetics and genomics, Current research, new ways to diagnose genetic conditions and genetic technologies that provide understanding of the genetic component to common chronic diseases are explored. Topics include family history, risk assessment, interventions, genetic testing and counseling, ethical and social issues and use of genetics and genomics to improve clinical practice. *Prerequisites: BI 152/L, CH 254/L, NUR 202, NUR 203.*

BI 311 Biostatistics (3)

Lecture course devoted to rigorous grounding in biological statistics, and in the application of statistical models to global health problems. Biostatistics is a lecture and hands-on course designed to provide students with the opportunity to develop statistical reasoning skills appropriate to analyze and implement biological experiments. Exemplars and case studies will be primarily derived from the public health field. Topics include principles of experimental design, sampling and variables, data categories and assumptions of parametric statistics, risk analysis, repeated measures, goodness of fit and contingency table analyses, and the general linear model. *Prerequisites: BI 206/L, MA 211.*

BI 312 Epidemiology (3)

This course covers epidemiologic concepts such as disease prevalence, penetration and risk. Epidemiological methodology will be addressed, including study design and interpretation for infectious and chronic diseases. Real data will be used to study an outbreak investigation, natural history of infectious diseases, validity of clinical tests, survival analysis, and clinical trial and etiologic studies. Epidemiologic concepts as applied to cohort and case-control studies will emphasize interpretation critical evaluation of observational study designs and data analysis. These concepts include measures of association, bias, confounding, and interaction/effect modification and determination of risk.

Prerequisites: BI 310. Recommended: MA 331.

BI 320 Developmental Biology I – Genetic control and patterning (3)

Cellular and molecular processes that govern the production of an embryo and the patterning of individual tissues and organs in a manner that is consistent with their physiological functionality. The effect of exogenous stimuli on body patterning in both physiological and pathophysiological situations will be addressed. *Prerequisites: BI 206/L, BI 208/L.*

BI 320L Developmental Biology Laboratory I – Genetic control and patterning (1)

Laboratory section accompanying BI 320. *Concurrent registration in BI 320 required. Materials intensive fee applies*

BI 321 Developmental Biology II – Comparative anatomy (3)

Comparative study of vertebrate structure, organization and adaptation. *Concurrent registration in BI 321L required. Prerequisites: BI 320/L.*

BI 321L Developmental Biology Laboratory I – Comparative anatomy (1)

One three-hour laboratory period per week to accompany BI 321. Laboratory dissections of organisms including lamprey, dogfish, and cat, as well as simulated gross anatomy of the human. *Concurrent registration in BI 321L required. Prerequisites: BI 320/L. Materials intensive fee applies*

BI 363 General Entomology (3)

Structure and function of the insects and closely related arthropods with emphasis on taxonomy, life cycles, distribution, and ecological relationships. Special emphasis will be given to groups of special significance to human health and well being. *Prerequisites: BI 208/L. Concurrent registration in BI 363L required.*

BI 363L General Entomology Laboratory (1)

One three-hour laboratory period per week to accompany BI 363. The laboratory will provide experience in collecting, mounting, and identification of insects to the family level, in addition to their structure. *Concurrent registration in BI 363 required.*

BI 387 Internship or field experience (1-3)

Supervised research work at a cooperating agency by arrangement; 45 hours of work required per credit. Student journal, progress reports, final paper, and agency supervisor's reports used in grading. May be repeated. No more than six semester hours of internship experience may be applied to graduation in biology. Offered every semester. *Prerequisites: junior or senior standing, one year of biology, and consent of instructor.*

BI 410 Physiology I – metabolism and nutrition (3)

Physiology of energetic and metabolic processes and endocrine control of metabolism in both healthy and disease states. Biochemistry of metabolism and the role of macro- and micronutrients in maintenance of homeostasis are examined. *Prerequisites: BI 208/L.*

BI 410L Physiology I Laboratory – metabolism and nutrition (1)

Laboratory section accompanying BI 410. *Concurrent registration in BI 410 required. Prerequisites: BI 208/L.*

BI 411 Physiology II - neurophysiology (3)

Fundamentals of neurophysiology from the cellular to the system levels. Discussion of neuroanatomy followed by the ionic and pharmacological basis of nerve and synaptic function. Specialized neuronal geometries and synaptic circuitries associated with a variety of sensory, motor and central systems. The laboratory covers extracellular and intracellular techniques in neurophysiology as well as sectioning and immunocytochemistry. *Prerequisites: BI 410/L*

BI 411L Physiology II Laboratory - neurophysiology (1)

Accompanying laboratory section to BI 411. *Concurrent registration in BI 411 required. Prerequisites: BI 410/L.*

BI 420 Systems Biology (3)

This course will focus on the frontiers of our understanding of the multi-level networks that underlie biological systems. Lecture course reviewing the key concepts of the systems biology approach to ecological, organismal and cellular systems. Contribution of cornerstone technologies such as genomics, bioinformatics, proteomics and metabolomics will be reviewed, along with their computational foundations. *Prerequisites: BI 208/L, BI 311.*

BI 471 Ecology (3)

Environmental-biological interrelations. Concepts of populations, communities, ecosystems, and conservation of resources by man. *Concurrent registration in BI 471L required. Prerequisites: BI 208/L.*

BI 471L Ecology Laboratory (1)

Laboratory section accompanying BI 471. *Concurrent registration in BI 471 required. Pre-requisites BI 208/L. Materials intensive fee applies.*

BI 480 Special Topics (1-3)

Selected topics in biology. Lecture or seminar topic in selected area of contemporary biology. May be repeated. *Prerequisites BI 208/L.*

BI 495 Research I (3)

Weekly seminar course accompanying research project (approximately 10 hours per week) performed in Chaminade or other research laboratory under supervision of a practicing research scientist. *Prerequisites: senior standing in biology and consent of program advisor. Materials intensive fee applies.*

BI 496 Topics Seminar (1)

Individualized in-depth research, readings and discussions on current topics. Includes intensive library and computer-based searches and several oral reports. Offered annually. *Prerequisites: Biology senior standing or approval of program advisor.*

BI 499 Research II (3)

Second semester of research project (approximately 10 hours per week) performed in Chaminade or other research laboratory under supervision of a practicing research scientist. Offered annually. *Prerequisites: BI 495. Materials intensive fee applies*

Elective Biology Courses:

BI 430 Infection and Immunity (3)

This course covers molecular and cellular immunology, including antigen and antibody structure and function, effector mechanisms, complement, major histocompatibility complexes, B- and T-cell receptors, hypersensitivity reactions, antibody formation and immunity, cytotoxic responses, and regulation of the immune response. Mechanisms of disease are also covered, including principles of microbiology and virology. *Prerequisites: BI 208/208L.*

BI 433 Molecular Evolution (3)

Investigations in the molecular basis of variation in populations. Association between selection, genetic drift, and other processes at molecular level and higher level patterns of diversity. Gene duplication and other genome alterations and novel gene function. Use of sequences and bioinformatic algorithms to study relatedness among groups of organisms. *Prerequisites: BI 208/L, BI 311. Materials intensive fee applies.*

BI 433L Molecular Evolution Laboratory (1)

Laboratory section accompanying BI 433. *Concurrent registration in BI 433 required. Prerequisites BI 208/L. Materials intensive fee applies.*

BI 435 Cancer Biology (3)

This course provides students with knowledge of the fundamental principles of the molecular and cellular biology of cancer cells. Lectures and demonstrations explain the role of growth factors, oncogenes, tumor suppressor genes, angiogenesis, and signal transduction mechanisms in tumor formation. Discussion of aspects of cancer epidemiology, prevention, and principles of drug action in cancer management is part of the course. *Prerequisites: BI 208/L.*

7.2. Biochemistry

Biochemistry Program

Program Advisors: Dr. Bulent Terem, Dr. Joel Kawakami, Professor Janet Jensen

Biology advisors: Dr. Jolene Cogbill, Dr. Michael Dohm, Dr. Joan Kuh, Ms Lisa Perry, Mr. Ron Iwamoto,
Dr. Helen Turner

Pre-health advisors: Ms Patricia Lee-Robinson; Ms Lisa Perry, Ms Janet Jensen.

Biochemistry Mission Statement.

Biochemistry is the study of the living organism at the molecular level. It draws on techniques from a broad spectrum of specialized branches of chemistry to study the molecular basis of vital processes. The mission of the Biochemistry Major program at Chaminade is to deliver an excellent education in biological chemistry, preparing students to be innovative, rigorous and well-trained scientists, educators or health practitioners. The biochemistry degree program recognizes that chemistry is ‘the central science’ and that biochemical processes are essential to all life on our planet. The biochemistry major is composed of sophisticated intellectual content and practical experiences. Students will be exposed to contemporary ideas in biology, a challenging range of chemistry courses and rigorous laboratory courses involving modern techniques and advanced instrumentation. Application of the scientific method, statistical and presentation skills, and critical evaluation of data are foundational to the course progression in the major, which culminates in a capstone research experience. Our undergraduate students experience an education that reflects the research interests and expertise of the faculty, specifically targeting the areas of natural products, synthetic and computational chemistry, cell and molecular biology, signal transduction, genetics and genomics, and integrative biology. The curriculum is synthesized with a rich program of available development activities including internships, conference attendance and preparation activities for the health professions and graduate school.

The vision of the Biochemistry major is linked to key components of the Chaminade educational experience. Our close-knit faculty fosters education in the family spirit, and the rapid progress in techniques and ideas that hallmark biology and chemistry drive our determination to prepare students who can adapt and change. Ultimately, the goal of science is to understand the mysteries of nature and improve the human condition, while recognizing the crucial hierarchy of all organisms within multi-level ecosystems. In particular, the goal of modern biochemistry is to develop novel molecules that address global problems, such as innovative therapies for disease, novel energy sources, and new biomaterials. Therefore, our program prepares graduate who will serve society and promote justice.

Biochemistry Program Learning Outcomes.

Upon completion of the B.S. degree program in Biochemistry the student will demonstrate:

1. An understanding of the scientific method and the ability to design and test a hypothesis;
2. The ability to visualize, statistically evaluate, validate and interpret scientific data, and to communicate science effectively both orally and in writing;
3. The ability to acquire and comprehend information from published scientific literature and to employ computational resources in the resolution of biological and chemical problems;

4. An understanding of the chemical and physical principles that unite all life forms, and of biological organization at the molecular, genetic and epigenetic, cellular, tissue, organ, organism and system levels;
5. An understanding of the principles of organic, inorganic, analytical and physical chemistry, with particular relationship to the biochemical processes of living organisms;
6. An understanding of the linkage between perturbations in biochemical pathways and the etiology of human disease, and of the potential for chemistry and biochemistry to yield therapeutic approaches;
7. An understanding of the entry requirements, career pathways and progression for the major post-graduate fields of research, education and the health professions.

Biochemistry Program Features:

The biochemistry program is supervised collaboratively between the Biology and Chemistry faculty at Chaminade University. Two degree programs are supported by the Biology discipline, the BS in Biology and the BS in Biochemistry. Two tracks are available within the BS in Biology, emphasizing Cellular and Molecular Biology and Integrative and Organismal Biology, respectively. When selecting a major program, students should be aware that the individual curricula are tailored to specific post-graduate preparation for careers. These are outlined in the table below.

Degree Awarded	B.S. in Biochemistry	B.S. in Biology	
		Cell and Molecular Biology Track	Integrative and Organismal Biology Track
Is there an undergraduate research requirement?	One semester Second semester elective	One semester Second semester elective	Optional as one semester elective
Is there an internship requirement?	Optional*	Optional *	Yes
What are the target post-graduate destinations for which this degree is designed?	Health professions (MD, Pharm.D etc) Graduate School in Chemistry/Biochemistry/Bio medical Sciences/Pharmacology Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc) Graduate School in Biological/Biomedical Sciences Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc) Graduate School in Biology Biotechnology Industry State and Federal Agencies
Is this program suitable for students who seek to enter medical or other health professional schools?	Yes – specifically pre-med seminar series, other enrichment activities and candidacy for Medical and other health professions Early Admissions Program. <i>*students who intend to apply for medical, dental, veterinary or other professional schools are encouraged to use internships to complete a professional shadowing experience.</i>		

Within the BS program in biochemistry, it is possible to elect the 'pre-med' area of emphasis. Here, students are enrolled in a seminar series and other activities that specifically prepare for standardized tests such as MCAT, and for entry into professional areas such as medicine, dentistry, pharmacy, physical therapy and others. In addition, this election admits the student to candidacy for the Chaminade Medical School Early Admissions Program. Here students may be guaranteed seats at medical schools including Western University College of Osteopathic Medicine, A.T. Stills College of Medicine and Boston University School of Medicine, following the successful completion of a specific course of study at Chaminade. Interested students should contact a pre-health advisor at their earliest opportunity to discuss this program.

BS in Biochemistry Major Requirements:

Pre-major: BI 099, BI 100, BI 104, BI 205, BI 205L, BI 206, BI 206L, BI 207, BI 207L, BI 208, BI 208L, BC 203, BC 203L, BC 204, BC 204L, BC 323, BC 323L, BC 324, BC 324L, BC 334/L, PHY 251, PHY 251L, PHY 252, PHY 252L, MA 210, MA 211.

Major: BI 300, BI 302, BC 360, BC 360L, BC 362, BC 362L, BI 320, BI 320L, BI 410, BI 410L, BI 420, BI 495, BC 430L, BC 420 and *two upper division electives chosen from:* CH 440/L, BI 320/L, CH 430, BI 430, BI 411/L, BI 321/L, CH 447/L, BI 435.

Biochemistry Minor Requirements:

BC 360/L, BC 362/L, BC 490, and *one upper division elective chosen from* BC 334/L, BC 420, CH 440/L.

Course Descriptions

See Biology Catalog section for Core and Upper Division Courses In Biology

See Chemistry Catalog Section for General Education Courses in Chemistry

BC 203 General Chemistry I (4)

A study of the general concepts and basic principles of chemistry: properties of matter, atomic and molecular structure, theories of bonding, chemical reactions and stoichiometry, equilibria, and ions in aqueous solution. Offered annually. *Prerequisites: MA 103. Concurrent registration in BC 203L required. Cross-listed as CH 203.*

BC 203L General Chemistry Laboratory (1)

Inorganic qualitative and quantitative analysis with emphasis on gravimetric, volumetric, and spectrophotometric techniques. One three-hour laboratory period per week to accompany BC 203. Offered annually. *Concurrent registration in BC 203 required. Cross-listed as CH 203L.*

BC 204 General Chemistry II (3)

Continuation of CH 203. Acids and bases, thermodynamics, electrochemistry, additional aspects of chemical equilibria, descriptive chemistry. Offered annually. *Prerequisites: MA 110, and CH 203 or equivalent. Concurrent registration in BC 204L required. Cross-listed as CH 204.*

BC 204L General Chemistry Laboratory II (2)

Two three-hour laboratory periods per week to accompany CH 204. Offered annually. *Concurrent registration in BC 204 required. Cross-listed as CH 204L.*

BC 323 Organic Chemistry I (4)

Chemistry of carbon compounds is investigated according to the functional group classification. A full understanding of organic reaction mechanisms is emphasized in order to guide the students through numerous reactions. Three-dimensionality of carbon compounds is introduced and referred to in the context of relevant reactions. Offered annually. *Prerequisites: CH 204/L. Concurrent registration in CH 323L required. Cross-listed as CH 323.*

BC 323L Organic Chemistry Laboratory I (1)

Separation and purification techniques such as distillation, recrystallization, liquid-liquid extraction are introduced. Having performed several functional interconversion reactions, students are competent to carry out multi-step syntheses by the end of the semester. Offered annually. *Concurrent registration in BC 323 required. Materials intensive fee applies. Cross-listed as CH 323L.*

BC 324 Organic Chemistry II (4)

Spectroscopic methods such as IR, NMR, MS, and UV/VIS are introduced to solve structural identifications of the different classes of compounds studied in the first semester. The chemistry of carbonyl compounds is investigated in detail and principles of multi-step syntheses are introduced. Biologically relevant molecules such as saccharides, amino acids, peptides, and nucleic acids are studied with the strong implication that structural features and principal chemical behaviors of these molecules are related to their biological functions. Offered annually. *Prerequisites: CH 323. Concurrent registration in BC 324L required. Cross-listed as CH 324.*

BC 324L Organic Chemistry Laboratory II (1)

Students are trained to carry out more complex reactions using sensitive reagents. Most of the semester is used to learn to determine partial and full structures of organic compounds utilizing qualitative chemical and spectroscopic analyses. Hands-on training with the actual instruments and with computerized simulations is offered. Students are also introduced to microscale reaction techniques and apparatus. Offered annually. *Concurrent registration in BC 324 required. Materials intensive fee applies. Cross-listed as CH 324L.*

BC 334 Analytical Chemistry (3)

A one-semester course in analytical chemistry where separation techniques and quantitative identifications of chemical entities are discussed. The quantitative techniques include gravimetric, volumetric, and potentiometric analyses. Sampling techniques and the statistical treatment of data are also discussed. Offered annually. *Prerequisites: CH 204, CH 323, and PHY 252. Concurrent registration in CH 334L required. Cross-listed as CH 334.*

BC 334L Analytical Chemistry Laboratory (1)

One three-hour laboratory period per week to accompany CH 334. Offered annually. *Concurrent registration in BC 334 required. Cross-listed as CH 334.*

BC 360 Biochemistry (3)

This is the first part of a yearlong course where the vast knowledge of biochemistry is filtered through a rational perspective guided by general chemical and biological principles. Following a survey and review of common classes of biologically significant metabolites such as peptides, carbohydrates, lipids, nucleic acids, as well as equally important smaller molecules, the emphasis is shifted to biological thermodynamics and enzyme mechanisms. During the latter part of the course the broad spectrum of

principles studied is utilized to cover individual metabolic pathways in detail. *Cross-listed as BI/CH 360. Prerequisites: BI 208/L, CH 204/L. Concurrent registration in BC 360L required.*

BC 360L Biochemistry Laboratory (1)

Students gain experience in the isolation, purification, identification, and quantification of biologically important molecules. Spectroscopic, chromatographic, as well as chemical modification techniques are used in identifying peptides and proteins. Enzyme kinetic studies are carried out for quantification purposes. *Cross-listed as BI/CH 360L. Concurrent registration in BC 360 required. Materials intensive fee applies.*

BC 362 Biochemistry II (3)

This is the second part of the yearlong biochemistry course, which starts with photosynthesis giving students a chance to review topics discussed during the previous semester such as oxidative phosphorylation and carbohydrate metabolisms. Continuing with individual metabolic pathways, lipids and amino acids are explored. The second half of the semester is mostly dedicated to nucleic acids, starting with nucleotide metabolism followed by a detailed study of information flow involving DNA and RNA. The course will conclude with a discussion of some contemporary techniques used in recombinant DNA technology. *Prerequisite: CH 360/L. Cross-listed as CH 362.*

BC 362L Biochemistry II Lab (1)

Contemporary experiments and simulations involving DNA and other nucleic acid metabolites. *Prerequisite: CH 360/L. Concurrent registration in BC 362 required. Cross-listed as CH 362L.*

BC 420 Physical Chemistry (3)

A one semester course covering thermodynamics, chemical equilibria and kinetics, quantum theory and applications to chemical bonding and spectroscopy. *Prerequisites: MA 211, CH 324, BC 360 and PHY 252*

BC 430L Instrumental Analysis (2)

This is a lab course during which students are expected to get hands-on experience with modern instrumentation, including but not limited to UV/VIS, FT IR, LC-MS, GC-MS. Following a discussion on the basic principles of each instrument, students will perform specific experiments and gather data from each instrument. Experiments during part of the course designated for topics in NMR spectroscopy will mostly be simulated. *Prerequisites: CH 324/L, CH 334/L. Concurrent registration in CH 440 required. Materials intensive fee applies*

BC 490 Chemistry Seminar I (1-2)

Special topics in organic, inorganic, physical, analytical, or biochemistry. Reading and discussion of current topics as well as expertise in modern library searching and retrieval methods to obtain information. One oral presentation by each participant required. *Prerequisites: CH 204/L. Cross-listed as CH 490.*

Elective Chemistry Courses:

CH 403 Inorganic chemistry (3)

Inorganic systems including bonding theories, structure, acid-base phenomena, and coordination compounds. *Prerequisite: CH 324.*

CH 440 Natural Product Chemistry (3)

The vast number of naturally occurring substances will be classified in terms of the biosynthetic-biogenetic pathways of their production. Polyketides, terpenes, alkaloids, as well as compounds with other and mixed biogenetic origins will be studied using mechanistic predictions introduced at the beginning of the course rather than a traditional descriptive approach. Secondary metabolites that are not emphasized in biochemistry courses will be highlighted with a view to understand their ecological significance, particularly in the field of chemical communication. Some interesting novel molecules isolated from marine organisms will be discussed. *Prerequisite: CH 362/L.*

CH 440L Natural Product Chemistry Lab (1)

The emphasis in this lab course will be on isolation and identification methods. Students will be introduced to various chromatographic techniques, from manual to automated, which they will apply to separation of particular natural products out of a crude mixture. Experiments using different methods such as normal/reversed phase, size exclusion, will enable students to select the best route for any specific purpose. During the second half of the course each student will be assigned to a mini-project, where students will be expected to learn how to use advanced instruments, such LC-MS, and evaluate the data for structure determination purposes. *Prerequisite: CH 362/L. Concurrent registration in CH 440 required.*

CH 447 Pharmacology (3)

Therapeutic actions of drugs at the cellular, tissue and organism level are discussed in areas of cancer, inflammation, cardiovascular, and endocrine related diseases. Preclinical and clinical results of each drug or drug classes are discussed with respect to therapeutic effectiveness. Included in the discussion are pharmacokinetic and toxicology. The course will be reading and writing intensive involving scientific literature research. The student will demonstrate an understanding of small and large molecule drug discovery and their therapeutics. *Prerequisite: BI 208/L, and CH 324/L.*

7.3. Chemistry

Chemistry Program

Program Advisors: Dr. Bulent Terem, Dr. Joel Kawakami, Professor Janet Jensen

Chemistry Mission Statement.

Chemistry has justifiably been labeled 'The Central Science'. Training in this discipline is essential for all citizens of the modern world. Since there is no material in the universe not made up of chemicals, a knowledge of chemistry is indeed a knowledge of ourselves.

The objectives of the Chemistry program are to

1. To promote molecular literacy, i.e., the growing awareness of the importance of understanding physical, chemical and biological changes on the atomic and molecular scale;
2. To demonstrate hands-on laboratory skills utilizing modern instrumentation and techniques;
3. To offer science majors the opportunity to engage in an undergraduate research program;
4. To enable students in other disciplines to demonstrate their integrated knowledge of the world about them.

Chaminade offers a minor in chemistry. Students interested in a chemistry-intensive major should refer to the Biochemistry program section of this catalog.

Degree requirements for the minor in Chemistry.

Pre-minor requirements: CH 203-CH 203L, CH 204-CH 204L, MA 110.

Minor requirements: 12 semester hours of upper division courses in chemistry and CH 490.

Learning Outcomes for the Minor in Chemistry

Upon completion of the undergraduate minor in Chemistry, the student will demonstrate an understanding of:

1. The scientific method and its application in Chemistry
2. The different areas of research and practice in Chemistry
3. The general concepts and principles of Chemistry

Course Descriptions.

CH 102 Chemistry for the Concerned World Citizen (3)

This is an introductory course presenting many different branches of chemistry. In contrast to other courses in the discipline, there is a significant qualitative component, where impact to environment, and how chemical knowledge can contribute to one's overall awareness are among the topics discussed. The quantitative part of the course is especially designed to be non-intimidating when covering concepts such as atomic theory, formulas, equations, thermochemistry, gases, and stoichiometry. Non-science majors, who wish to relate general principles of chemistry to socioeconomic and environmental issues, as well as science majors, who feel the need for a refresher course, are encouraged to enroll. Offered annually. *Prerequisites:* High school algebra recommended.

CH 102L Chemistry for the Concerned World Citizen Laboratory (1)

The general theme for this lab course is to demonstrate that chemistry is everywhere. A great majority of the experiments will be carried out using household supplies and equipment. During the last few weeks a transition to using conventional lab equipment is aimed to help students understand the logic of experimental design. One three-hour laboratory period per week to accompany CH 102. Offered annually.

CH 103 College Chemistry (3)

A one semester introduction to chemistry for students who wish to strengthen their understanding of basic concepts in chemistry before beginning the general chemistry sequence or for students working towards associate degrees. Emphasis will be placed on problem solving. Topics covered will include: chemical measurements, properties of atoms and molecules, chemical reactions, chemical calculations, acids and bases, properties of gases and thermochemistry. Offered annually. (Concurrent registration in CH 103L required).

CH 103L College Chemistry Laboratory (1)

Laboratory experiments designed to reflect the topics presented in CH 103. Offered annually. *Concurrent registration in CH 103 required.*

CH 107 Marine Sciences: Chemical Perspectives (3)

This course acquaints the non-specialist with the multi-faceted marine environment. The topics covered range from wave action and reef eco-systems to marine invertebrates and drugs from the sea. Many unique features of the marine environment around the Hawaiian Islands are also covered. Offered annually. *Prerequisites: Concurrent registration in CH 107L and consent of instructor required.*

CH 107L Marine Sciences: Chemical Perspectives Laboratory (1)

Hands-on experience in data-collection and processing, observations of marine eco-systems, sample collecting, and isolation techniques are introduced through field trips and laboratory experiments. One three-hour laboratory period per week to accompany CH 107. Offered annually.

CH 201 General Chemistry for Nursing (3)

A one semester, general chemistry course with an emphasis for the nursing majors. The topics covered include the structure of matter, the properties of solutions and gases, radioactive isotopes and the chemistry of acids and bases. This course is not a substitute for CH 203/204 for the Biology or Forensic Sciences majors. This course may not be used to satisfy the Natural Science General Education requirement. *Offered annually. Prerequisites: BI 151 and BI 151/L, BI 152 and BI 152L and MA 107 or equivalent with grade of C or better is required. Concurrent registration in CH 201L.*

CH 201L General Chemistry for Nursing Laboratory (1)

Laboratory to accompany CH 201 One three-hour laboratory per week will include introduction to the fundamental principles and models of chemistry and related exercises and experimentation. *Prerequisites: BI 151L and BI 152L. Concurrent registration in CH 201 required.*

CH 203 General Chemistry I (4)

A study of the general concepts and basic principles of chemistry: properties of matter, atomic and molecular structure, theories of bonding, chemical reactions and stoichiometry, equilibria, and ions in aqueous solution. Offered annually. *Prerequisites: MA 103. Concurrent registration in CH 203L required. Cross-listed as BC 203.*

CH 203L General Chemistry Laboratory (1)

Inorganic qualitative and quantitative analysis with emphasis on gravimetric, volumetric, and spectrophotometric techniques. One three-hour laboratory period per week to accompany CH 203. Offered annually. *Concurrent registration in CH 203 required. Cross-listed as BC 203L.*

CH 204 General Chemistry II (3)

Continuation of CH 203. Acids and bases, thermodynamics, electrochemistry, additional aspects of chemical equilibria, descriptive chemistry. Offered annually. *Prerequisites: MA 110, and CH 203 or equivalent. Concurrent registration in CH 204L required. Cross-listed as BC 204.*

CH 204L General Chemistry Laboratory II (2)

Two three-hour laboratory periods per week to accompany CH 204. Offered annually. *Concurrent registration in CH 204 required. Cross-listed as BC 204L.*

CH 254 Survey of Organic and Bioorganic Chemistry for Nursing (3)

An introductory course aiming at surveying what goes on within biological systems from a molecular point of view, with an emphasis on specific ecological interactions. Offered annually. *Prerequisites: CH 201 or consent of instructor, BI 151 and BI 151L, BI 152 and BI 152L and completion of MA 107 or equivalent with grade of C or better is required. Concurrent registration in CH 254L required.*

CH 254L Survey of Organic and Bioorganic Chemistry for Nursing Laboratory (1)

Laboratory to accompany CH 254. One three-hour laboratory per week will include introduction to the fundamental principles and models of chemistry and related exercises and experimentation. *Prerequisites: BI 151L and BI 152L. Concurrent registration in CH 254 required.*

CH 323 Organic Chemistry I (4)

Chemistry of carbon compounds is investigated according to the functional group classification. A full understanding of organic reaction mechanisms is emphasized in order to guide the students through numerous reactions. Three-dimensionality of carbon compounds is introduced and referred to in the context of relevant reactions. Offered annually. *Prerequisites: CH 204/204L. Concurrent registration in CH 323L required. Cross-listed as BC 323.*

CH 323L Organic Chemistry Laboratory I (1)

Separation and purification techniques such as distillation, recrystallization, liquid-liquid extraction are introduced. Having performed several functional interconversion reactions, students are competent to carry out multi-step syntheses by the end of the semester. Offered annually. *Concurrent registration in BC 323 required. Materials intensive fee applies. Cross-listed as BC 323L.*

CH 324 Organic Chemistry II (4)

Spectroscopic methods such as IR, NMR, MS, and UV/VIS are introduced to solve structural identifications of the different classes of compounds studied in the first semester. The chemistry of carbonyl compounds is investigated in detail and principles of multi-step syntheses are introduced. Biologically relevant molecules such as saccharides, amino acids, peptides, and nucleic acids are studied with the strong implication that structural features and principal chemical behaviors of these molecules are related to their biological functions. Offered annually. *Prerequisites: CH 323. Concurrent registration in CH 324L required. Cross-listed as BC 324.*

CH 324L Organic Chemistry Laboratory II (1)

Students are trained to carry out more complex reactions using sensitive reagents. Most of the semester is used to learn to determine partial and full structures of organic compounds utilizing qualitative chemical and spectroscopic analyses. Hands-on training with the actual instruments and with computerized simulations is offered. Students are also introduced to microscale reaction techniques and apparatus. Offered annually. *Concurrent registration in CH 324 required. Materials intensive fee applies. Cross-listed as BC 324L.*

CH 334 Analytical Chemistry (3)

A one-semester course in analytical chemistry where separation techniques and quantitative identifications of chemical entities are discussed. The quantitative techniques include gravimetric, volumetric, and potentiometric analyses. Sampling techniques and the statistical treatment of data are also discussed. Offered annually. *Prerequisites: CH 204, CH 323, and PHY 252. Concurrent registration in CH 334L required. Cross-listed as BC 334.*

CH 334L Analytical Chemistry Laboratory (1)

One three-hour laboratory period per week to accompany CH 334. Offered annually. *Concurrent registration in CH 334 required. Cross-listed as BC 334.*

CH 360 Biochemistry (3)

This is the first part of a yearlong course where the vast knowledge of biochemistry is filtered through a rational perspective guided by general chemical and biological principles. Following a survey and review of common classes of biologically significant metabolites such as peptides, carbohydrates, lipids, nucleic acids, as well as equally important smaller molecules, the emphasis is shifted to biological thermodynamics and enzyme mechanisms. During the latter part of the course the broad spectrum of principles studied is utilized to cover individual metabolic pathways in detail. *Cross-listed as BI/BC 360. Prerequisites: BI 208/208L, CH 204/204L. Concurrent registration in CH 360L required.*

CH 360L Biochemistry Laboratory (1)

Students gain experience in the isolation, purification, identification, and quantification of biologically important molecules. Spectroscopic, chromatographic, as well as chemical modification techniques are used in identifying peptides and proteins. Enzyme kinetic studies are carried out for quantification purposes. *Cross-listed as BI/BC 360L. Concurrent registration in CH 360 required. Materials intensive fee applies.*

CH 362 Biochemistry II (3)

This is the second part of the yearlong biochemistry course, which starts with photosynthesis giving students a chance to review topics discussed during the previous semester such as oxidative phosphorylation and carbohydrate metabolisms. Continuing with individual metabolic pathways, lipids and amino acids are explored. The second half of the semester is mostly dedicated to nucleic acids, starting with nucleotide metabolism followed by a detailed study of information flow involving DNA and RNA. The course will conclude with a discussion of some contemporary techniques used in recombinant DNA technology. *Prerequisite: CH 360/L. Cross-listed as BC 362.*

CH 362L Biochemistry II Lab (1)

Contemporary experiments and simulations involving DNA and other nucleic acid metabolites. *Prerequisite: CH 360/L. Concurrent registration in CH 362 required. Cross-listed as BC 362L.*

CH 420 Physical Chemistry (3)

A one semester course covering thermodynamics, chemical equilibria and kinetics, quantum theory and applications to chemical bonding and spectroscopy. *Prerequisites: MA 211, CH 324, BC 360 and PHY 252. Cross-listed as BC 420.*

CH 430L Instrumental Analysis (2)

This is a lab course during which students are expected to get hands-on experience with modern instrumentation, including but not limited to UV/VIS, FT IR, LC-MS, GC-MS. Following a discussion on the basic principles of each instrument, students will perform specific experiments and gather data from each instrument. Experiments during part of the course designated for topics in NMR spectroscopy will mostly be simulated. *Prerequisites: CH 324/L, CH 334/L. Materials intensive fee applies. Cross-listed as BC 430L.*

CH 490 Chemistry Seminar I (1-2)

Special topics in organic, inorganic, physical, analytical, or biochemistry. Reading and discussion of current topics as well as expertise in modern library searching and retrieval methods to obtain information. One oral presentation by each participant required. *Prerequisites: CH 204/L.*

CH 480. Special Topics in Chemistry (1-3). Advanced and specialized chemistry topics. *Prerequisites: CH 324/L.*

Elective Chemistry Courses:

CH 403 Inorganic chemistry (3)

Inorganic systems including bonding theories, structure, acid-base phenomena, and coordination compounds. *Prerequisite: CH 324*

CH 440 Natural Product Chemistry (3)

The vast number of naturally occurring substances will be classified in terms of the biosynthetic-biogenetic pathways of their production. Polyketides, terpenes, alkaloids, as well as compounds with other and mixed biogenetic origins will be studied using mechanistic predictions introduced at the beginning of the course rather than a traditional descriptive approach. Secondary metabolites that are not emphasized in biochemistry courses will be highlighted with a view to understand their ecological significance, particularly in the field of chemical communication. Some interesting novel molecules isolated from marine organisms will be discussed. *Prerequisite: CH 362/L.*

CH 440L Natural Product Chemistry Lab (1)

The emphasis in this lab course will be on isolation and identification methods. Students will be introduced to various chromatographic techniques, from manual to automated, which they will apply to separation of particular natural products out of a crude mixture. Experiments using different methods such as normal/reversed phase, size exclusion, will enable students to select the best route for any

specific purpose. During the second half of the course each student will be assigned to a mini-project, where students will be expected to learn how to use advanced instruments, such LC-MS, and evaluate the data for structure determination purposes. *Prerequisite: CH 362/L. Concurrent registration in CH 440 required.*

CH 447 Pharmacology (3)

Therapeutic actions of drugs at the cellular, tissue and organism level are discussed in areas of cancer, inflammation, cardiovascular, and endocrine related diseases. Preclinical and clinical results of each drug or drug classes are discussed with respect to therapeutic effectiveness. Included in the discussion are pharmacokinetic and toxicology. The course will be reading and writing intensive involving scientific literature research. The student will demonstrate an understanding of small and large molecule drug discovery and their therapeutics. *Prerequisites: BI 208/L, and CH 324/L.*

8. Alterations to FS catalog.

Add

FS 435 Applied Toxicology (3)

Absorption, distribution, metabolism and excretion of pharmaceutical, environmental and forensically relevant compounds. Analysis and detection techniques. *Prerequisites BI 208/L.*

Relocate from Biology Catalog to FS

FS 444 Forensic Biology (3)

A scientific examination of biological evidence. Includes examining the scientific basis of many types of biological evidence, applying scientific methods to, and interpretation of biological evidence. *Cross-listed as FS 444. Prerequisites: BI 208/L, CJ/FS 330, CH 204/L. Concurrent registration in BI/FS 444L is required.*

FS 444L Forensic Biology Laboratory (1)

One three-hour laboratory period per week to accompany BI 444. Laboratory work includes topics such as blood analysis and identification, use of chromatographic and electrophoretic techniques, and PCR as applicable to forensic identification. *Concurrent registration in BI 444 required. Materials intensive fee applies.*

9. Resource implications

The 2009-2010 Catalog contains 67 biology courses. The proposed 2011-2012 catalog contains 60 biology courses. The additional chemistry courses necessary for the biochemistry major number 3 courses and 3 electives. The search for a new faculty member who will be jointly appointed in FS and Chemistry is underway in Spring 2010 and is an approved component of the 2011-2012 budget. Carl Sung has been hired in January 2011 (fully funded for 5 years by the BRIC NIH grant) to act as an Advanced Instrumentation Technician who will facilitate the inclusion of advanced instruments into courses such as cell biology, molecular biology, biotechniques, instrumental analysis etc.

Our existing faculty will teach the core and upper division courses for which there are clear parallels between old and new programs. Expertise is also available in the Division as follows to cover new areas of emphasis in the new curricula. These are not meant as determination of who will teach what, but to illustrate our range of expertise.

Biochemistry II	Terem, Kawakami, new FS/Chem
Physical Chemistry	Jensen
Instrumental Analysis	Terem, Kawakami, new FS/Chem (support staff Sung)
Biotechniques II	Cogbill (support staff Sung)
Epidemiology	White (faculty-in residence effective 2010)
Infection and Immunity	Turner
Systems Biology	Turner/Dohm
Pharmacology	Terem, Kawakami, Turner, new FS/Chem
Molecular Evolution	Dohm
Applied Toxicology	Turner/ new FS/Chem
Cancer Biology	Turner, Kawakami, Cogbill
Natural Products	Terem
Neurophysiology	adjunct (Trapido-Rosenthal)

10. Proposed Timeline(s)

Step	Timeline	
NSM internal approval for BI and BCH four year plan* <i>* can be subject to later revisions</i>	By February 9 2011* <i>(*hard deadline in order to make AY11-12 catalog)</i>	
Academic Council approval of new structure and 4 year plan	Mid-Feb 2011 <i>(1st reading)</i> Mid-March 2011 <i>(2nd reading)</i>	
New four year plan and major go into catalog	Fall 2011	
Development of 1 st year courses BI 099, 100, 205/L BI 104, 206/L	<p>Academic Council</p> <p>First Reading Second Reading</p> <p>(Testing of laboratory exercises and development of teaching materials)</p> <p>First Reading Second Reading</p> <p>(Testing of laboratory exercises and development of teaching materials)</p>	<p>March 2011 April 2011</p> <p>Spring/summer 2011: note that <i>summer salaries for these activities available through the NIH BRIC grant</i></p> <p>Sept 2011 October 2011</p> <p>FD11</p>
First class of two new majors	Fall 2011	
Graduate first class of two new majors	Summer 2015	

