Biology Program

Pepperdine University

Jul 18, 2016

Pepperdine University Program Review

Biology Program

INTRODUCTION

The Biology Program is within the Natural Science Division, which is one of eight divisions in Seaver College at Pepperdine University. Biology represents one of seven primary majors offered by the Natural Science Division, and students in the Biology Program are offered two degree paths, Bachelor of Arts in Biology or Bachelor of Science in Biology. These two degree options differ primarily in the amount of chemistry required. For instance, the BA degree requires four units of CHEM 301 (Elementary Organic Chemistry), whereas students seeking the BS degree must take eight units of Organic Chemistry (CHEM 310 and 311) plus Cellular Biochemistry (CHEM 330). In 2009 the Biology Program implemented a requirement of MATH 210 (Analytic Geometry and Calculus I) for both the BA and BS degrees. This change was deemed necessary to prepare students for physics. The Biology Program also offers courses required for the Secondary Teaching Credential, and students majoring in biology have the opportunity to minor in several areas within the Natural Science Division, including mathematics, chemistry, and computer science. Many pre-medical students have majors (e.g., Sports Medicine, Biochemistry, Philosophy, Psychology, etc.) other than biology, yet must take several biology courses to meet admission requirements. The Biology Program accommodates these students as well as our biology majors. Finally, our program offers several biology courses (BIOL 105 - Introduction to Marine Biology; BIOL 106 - Principles of Biology; BIOL 107 - Plants and the Environment; BIOL 108 - Genetics and Human Affairs; BIOL 109 - Introduction to Animal Behavior) that meet the GE requirement of a lab science course for non-majors.

Provide a brief history of the program.

Similar to most biology programs in the United States, a large contingency of students in the Biology Program at Pepperdine are interested in various health professions. This appears to be increasing each year, primarily as a result of the successful admission rate for our students who apply to medical school. As a result, enrollment is higher in upper division classes biased towards courses deemed more appropriate for pre-medical students. Although many of our students are interested in health professions, a reasonably high percentage also are interested in non-medical careers in biology. These students tend to seek advanced degrees upon matriculation from Pepperdine.

One primary goal of the Biology Program is to provide students with broad exposure to the major disciplines in biology, and we feel that such training should be more than simply standard lectures and prescribed laboratory experiments. We strive to teach our students the critical thinking skills necessary for a career in science, and this includes medicine. Therefore, we try to provide students with opportunities for experiential learning through involvement in undergraduate research. As such, all majors in biology are encouraged to participate in the Honors Research Program, which is designed to promote independent research by students that will culminate in a degree depicting Honors in Biology. Requirements for Honors include a written thesis, oral presentation of the thesis research to all students and faculty within the division, and defense of the thesis in front of an honors thesis committee. In addition, members of the biology faculty direct a summer program for undergraduate research that focuses on students interested in

careers in biology. Funding sources for this program include: 1) an extramural grant for undergraduate research from the National Science Foundation; 2) support from SURP (Summer Undergraduate Research Program) from Seaver College; and 3) private endowments and contributions.

Describe the changes made to the program since the last review.

We continue to offer two of our core courses (BIOL 211 - Biology of Cells and BIOL 212 - Animal Biology) during the freshman year. Although we tried to use a similar textbook (Biology by Campbell et al.), professors teaching these two courses felt that the book is not suitable for their course outlines. Therefore, different textbooks are being used in these two courses.
All biology majors are required to enroll in BIOL 110 (Colloquium for First-Year Biology Majors). The format of this colloquium has changed. Rather than meeting once per week, students now participate in group research projects that result in analysis of data and presentation of their results. This has shortened the meeting time, and these activities allow for students to become actively involved. We now introduce students to all members of the faculty in biology through visitations of each research lab, and students are taught about various careers in biology.
Enrollment in advanced courses in biology now require a C minus or better in any prerequisite courses. This change was initiated in fall of 2015, and we hope that the change will encourage low performing students to seek a major more suitable to their interests and expertise.
We are in the process of modifying the upper division requirements for students seeking a BA degree in biology. Beginning next year, CHEM 330 (Cellular Biochemistry) can be taken as one of the upper division electives. This will help many students interested in medical school, and it might help with retention of these students in the Biology Program.
Biology of Plants (BIOL 213) is one of the three lower division courses in the biology core curriculum. This course requires an independent research project that involves proposal writing, data collection and analysis, and oral and poster presentations of original research. BIOL 311 (Introduction to Ecology) is a required upper division course, and it also has an independent research requirement. We are now coordinating how these research projects are being assessed. For instance, the same assessment rubric is used in both courses as well as the same description of the project requirements, including the poster presentation. Research exercises in both these courses are being assessed longitudinally.
Senior Seminar (BIOL 491) is a one unit course taken in the spring of the senior year. This course is designed to be a capstone course that assesses mastery of program learning outcomes 1 (display an understanding of biological systems and evolutionary processes) and 3 (demonstrate preparedness for service and leadership in science related issues affecting society). Additionally, students must show development of program learning outcome 2 (proficiency at applying principles of the scientific method to problems in biology). Professor Tom Vandergon teaches this course, and he now uses a combination of direct, indirect, and authentic assessment protocols, including an AAC&U writing analysis.
Rather than relying on a full-time visiting professor, Dr. Javier Monzon is a newly hired assistant professor in biology. Additionally, Krista Lucas is an adjunct who currently teaches BIOL 106 (Principles of Biology), a GE course for non-majors.

2. THE EXTERNAL CONTEXT
This should explain how the program responds to the needs of the area in which it serves: this can include the community, region, field, or discipline.

The Natural Science Division, including the Biology Program, at Pepperdine University is well known to communities in California. A large majority of incoming students admitted to the division and the Biology Program are from California. For instance, 53.7% of students receiving acceptance to the Natural Science Division in 2014 were from California, and 53% of the

incoming freshman class was from California.
Biology students enrolled in Senior Seminar (BIOL 491) participate in a service learning project that involves teaching biological concepts to middle and high school students. Generally, these projects are associated with local and regional schools in the Malibu area. In addition, one of our biology graduates, Nadia Despenza, is the STEM Coordinator for the YouthBuild Charter School in Central Los Angeles. Biology students in our SURB (Summer Undergraduate Research in Biology) program host students from this charter school and provide hands-on exposure to various types of research in biology.
Both faculty and students in the Biology Program actively participate in SCCUR (Southern California Conference for Undergraduate Research). This yearly conference allows our undergraduates to present original research in a professional setting. One of our professors, Jay Brewster, is on the SCCUR board, and several years ago we hosted SCCUR at Pepperdine. Some of our faculty in biology are also members of the Council on Undergraduate Research and have judged abstracts for the annual meeting.
The majority of the biology faculty contribute to their discipline through annual attendance at professional meetings and service to various societies and journals. The following is a list of some of the professional activities performed by the biology faculty: 1) Professor Jay Brewster - member of Board of Directors of SCCUR and member of American Society for Cell Biology, member of Congressional Liaison Committee, member of Council for Undergraduate Research, participates in Project Kaleidoscope, and member of Genome Consortium for Active Teaching; 2) Professor Steve Davis - Board Member of Southern California Conferences for Undergraduate Research and member of Ecological Society of America, Botanical Society of America, and American Society for the Advancement of Science; 3) University Professor Rodney Honeycutt - Editorial Board, Molecular Phylogenetics and Evolution, Associate Editor, BMC Evolutionary Biology, Section Editor, BMC Research Notes, Specialty Chief Editor for Phylogenetics, Phylogenomics and Systematics, Frontiers in Ecology and Evolution, Handling Editor, Royal Society's Biology Letters, Conservation Committee Member for American Society of Mammalogists, and member of American Society of Mammalogists, Society for the Study of Evolution, Society of Systematic Biology, and the American Association for Advancement of Science; 4) Professor and Vice Provost Lee Kats - Associate Editor for Hydrobiologia, Editorial Board for Conservation Biology, Marine Conservation Research Institute Board for the Aquarium of the Pacific, and member of Association for Tropical Biology and Conservation, Society for Conservation Biology, International Society of Behavioral Ecology, Animal Behaviour Society, Ecological Society of America, Society for the Study of Amphibians and Reptiles, and American Society of Ichthyology and Herpetology; 5) Professor Karen Martin - Treasurer for the Society for Integrative and Comparative Biology, Associate Editor of Physiological Ecology, Member of the Board of Governors for the American Society of Ichthyologists and Herpetologists, and technical advisor for the Santa Monica Bay Restoration Commission; 6) Assistant Professor Javier Monzon - Member of Advisory Board of Northeast Wolf Coalition, member of American Society of Mammalogists; 7) Associate Professor Donna Nofziger Plank - Member of the American Society of Cell Biology and the Society for Developmental Biology; 8) Professor Tom Vandergon - member of the Society for the Study of Evolution and Sigma Xi

PROGRAM OUTCOMES

Institutional Learning Outcomes

Identifier	Description
CA-PEP-ILO-15.L-1-KS	Think critically and creatively, communicate clearly, and act with integrity.
CA-PEP-ILO-	Practice responsible conduct and allow decisions and directions to be

15.L-2-FH	informed by a value-centered life.
CA-PEP-ILO-15.L-3-CGU	Use global and local leadership opportunities in pursuit of justice.
CA-PEP-ILO-15.P-1-KS	Demonstrate expertise in an academic or professional discipline, display proficiency in the discipline, and engage in the process of academic discovery
CA-PEP-ILO-15.P-2-FH	Appreciate the complex relationship between faith, learning, and practice.
CA-PEP-ILO-15.P-3-CGU	Develop and enact a compelling personal and professional vision that values diversity
CA-PEP-ILO-15.S-1-KS	Apply knowledge to real-world challenges.
CA-PEP-ILO-15.S-2-FH	Respond to the call to serve others.
CA-PEP-ILO-15.S-3-CGU	Demonstrate commitment to service and civic engagement.

Additional Standards/Outcomes

Identifier	Description
CA-PEP-SVR-15.BIOLOGY-1	Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.
CA-PEP-SVR-15.BIOLOGY-2	Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.
CA-PEP-SVR-15.BIOLOGY-3	Students will demonstrate preparedness for service and leadership in science related issues affecting society.

CURRICULUM MAP

MISSION, PURPOSES, GOALS, AND OUTCOMES

The primary mission of the Biology Program at Pepperdine University is to provide students with comprehensive knowledge of biological complexity and to equip students with the fundamental learning skills and preparation necessary for careers in the life sciences. Many of these careers involve continuing education through entry into professional schools (e.g., medicine, dentistry, veterinary medicine, optometry, etc.) and graduate schools. In addition, the Biology Program provides training in science for those students seeking a liberal arts education, as well as students interested in science education. Our pedagogical approach is to combine experiential-learning through student research and laboratory exercises with more traditional formats, such as lecture and class discussions that integrate biological concepts with discovery-based research performed by the students. Finally, our curriculum emphasizes the principle of evolution as one of the major unifying theories in biology. At the same time, all members of the faculty in biology embrace the overall mission of Pepperdine University. As such, we emphasize that faith and scientific reason are not mutually exclusive worldviews, and this goal aligns well with the overall mission of both Seaver College and Pepperdine University.

The objectives and goals of the Biology Program at Pepperdine University are to:
1) emphasize that a sense of vocation requires an integration of faith and training in a particular field of endeavor as well as the utilization of that vocation for a life of service;
2) explain the foundational concept of evolution by natural selection through detailed studies of comparative anatomy, paleontology, cytology, genetics, molecular biology, and ecology;
3) teach critical thinking and the application of the scientific method in biological research;
4) provide training in the enterprise of science, including the design of a research project, the implementation of a detailed literature search on a topic of research, the analysis and interpretation of scientific data, and the presentation of research in both written and verbal formats;
5) develop first-hand knowledge of experimental techniques for both laboratory and field research;
6) provide access to undergraduate research activities under the direction of members of the biology faculty, including the opportunity to design and implement an honors thesis;
7) foster understanding of ethical issues in biology related to human genetics, environmental policy, biomedical treatments, and research design;
8) make students aware of the diverse career opportunities in the biological sciences and provide guidance on how to successfully compete for advanced training in biology after graduation.

The Biology Program identified three primary learning outcomes. They are as follows:
1) Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.
2) Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.
3) Students will demonstrate preparedness of students for service and leadership in science related issues affecting society.

The matrix in Table 1 (see attachment) shows courses available for biology majors and the level of learning expected for each course. Some courses are primarily introductory, others provide both introductory material and practice, and some upper division courses require mastery in one or more of the learning outcomes. Table 2 (attached) presents an alignment map that relates learning outcomes identified by the Biology Program with those outlined by Seaver College and the Natural Science Division. Biology courses related to both sets of learning outcomes are listed on the right hand side of the table.

I - Introduced
D - Developed
M - Mastered

BIOL Curriculum Map

	BIOL 110	**BIOL 211**	**BIOL 212**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	I	I	I
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project,	I	D	D

collection and analysis of data, and interpretation of data in both written and oral formats.			
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.	I	I	I

	BIOL 213	**BIOL 311**	**BIOL 328**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	I	D	I
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.	D	M	D
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.	I	D	M

	BIOL 330	**BIOL 331**	**BIOL 340**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	D	D	D
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.	D	D	D
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.			I

	BIOL 350	**BIOL 390**	**BIOL 410**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	M	D	D
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written	D	D	D

and oral formats.			
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.	D	I	

	BIOL 411	**BIOL 420**	**BIOL 430**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	D	D	D
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.	M	D	M
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.		I	D

	BIOL 440	**BIOL 450**	**BIOL 460**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	D	D	D
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.		D	D
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.		D	

	BIOL 470	**BIOL 490**	**BIOL 491**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	D	D	M
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.	D	D	

CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.	I		M

	BIOL 492	**BIOL 499**
CA-PEP-SVR-15.BIOLOGY-1 Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	D	D
CA-PEP-SVR-15.BIOLOGY-2 Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.	M	M
CA-PEP-SVR-15.BIOLOGY-3 Students will demonstrate preparedness for service and leadership in science related issues affecting society.		

Aligment of PLOs with ILOs

Table 2 - Alignment Map of Learning Outcomes
School: Seaver College/Natural Science Division
Program: Biology

Student Learning Outcomes from IEOs	Program Learning Outcomes (PLOs)	Courses
Demonstrate expertise in an academic or professional discipline, display proficiency in the discipline, and engage in the process of academic discovery.	Display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.	BIOL 110 BIOL 211 BIOL 212 BIOL 213 BIOL 311 BIOL 330 BIOL 331 BIOL 340 BIOL 350 BIOL 390 BIOL 411 BIOL 420 BIOL 430 BIOL 440 BIOL 450 BIOL 460 BIOL 470 BIOL 490 BIOL 599
Explore the complex relationship between faith, learning, and practice.	Demonstrate preparedness of students for service and leadership in science related issues affecting society.	BIOL 110 BIOL 212 BIOL 328 BIOL 350 BIOL 491
Develop and enact a compelling personal and professional vision that values diversity.		
Apply knowledge to real-world challenges.	Demonstrate preparedness of students for service and leadership in science related issues affecting society	BIOL 110 BIOL 211 BIOL 212 BIOL 213 BIOL 311 BIOL 328 BIOL 350 BIOL 390 BIOL 420 BIOL 430 BIOL 450

ANALYSIS OF EVIDENCE: Meaning

Meaning

Institutional mission and learning outcomes - The Department of Biology have identified three primary learning outcomes. They are as follows:
1) Students will display an understanding of biological systems and evolutionary processes spanning all ranges of biological complexity including molecules, genes, cells, organisms, communities, and ecosystems.

2) Students will be proficient at applying principles of the scientific method to problems in biology, including the formulation of a hypothesis, implementation of a research project, collection and analysis of data, and interpretation of data in both written and oral formats.

3) Students will demonstrate preparedness of students for service and leadership in science related issues affecting society.

As indicated earlier, the Biology Program's learning outcomes align well with most of the Pepperdine's mission and Seaver College's learning outcomes. For instance, courses in our overall program meet the following institutional learning outcomes: 1) demonstrate expertise in an academic or professional discipline, display proficiency in the discipline, and engage in the process of academic discovery; 2) explore the complex relationship between faith, learning, and practice; 3) apply knowledge to real-world challenges; 4) recognize the responsibility and call to use one's talents in the service of others rather than merely for personal or material gain; 5) demonstrate commitment to service and civic engagement; 6) read widely, think critically, and communicate clearly; 7) engage in responsible conduct and allow decisions and directions to be informed by a value-centered life; and 8) use global and local leadership opportunities in pursuit of justice.

How does the degree embody the distinct values, basic commitment, and traditions of the institution?

Institutional values, commitment, traditions - Pepperdine is a faith-based institution that is committed to the pursuit of academic excellence. As a Christian institution, Pepperdine strives to create an environment where the pursuit of knowledge is integrated with faith. One major institutional goal is to prepare students for a vocational journey that includes application of their gained knowledge for service and leadership. The Biology Program embraces the fundamental mission of Pepperdine University. The curriculum and instruction in biology focuses on concepts and principles (e.g., evolution, climate change, environmental stewardship, stem cell research, cloning), many of which can sometimes challenge people from diverse political and religious backgrounds. All members of the biology faculty emphasize these basic scientific ideas in an objective manner and do not strive to compromise the information. At the same time, many of our biology courses (ecology, genetics, environmental policy and politics, cell/molecular biology) allow for open discussion about faith, ethics, and science. Our basic philosophy is that college, especially Pepperdine, should be a place for honest discussions that allow students to grow intellectually and spiritually.

Is there a coherent, aligned sequence of learning opportunities?

The Biology Program requires a sequence of learning opportunities that allow students to progress from their lower division courses to more advanced levels of study in their upper division

courses (see alignment and specific course learning outcomes in attachment). In terms of the Biology Program's three learning outcomes, the lower division courses (BIOL 211, BIOL 212, BIOL 213) introduce students to concepts in biology (PLO 1). This helps students develop their biological vocabulary and skills necessary for more advanced courses. For instance, BIOL 213 (Biology of Plants), a foundational core course, helps students develop their skills associated with PLO 2, which emphasizes applying of the scientific method in original research and communicating the information gained through verbal and written communication. BIOL 311 (Ecology) expects mastery of the requirements associated with PLO 2. These foundational courses also introduce students to how biological information relates to society in general (PLO 3). At the same time, BIOL 350 (Genetics) expects mastery of PLO 3, as this course expands upon concepts learned in BIOL 211 and BIOL 212. Both BIOL 328 and BIOL 491 expect mastery of PLO 3, and the connection of biology to important societal issues are assessed by students addressing real-world problems and presenting their solutions through verbal and written communication. These particular courses require students to work in teams, which builds leadership skills. The problems presented to students in these courses do not necessarily have an exact solution, and in many cases various stakeholders might disagree about how to interpret information. Therefore, students gain firsthand knowledge about how biology interfaces with society at many levels ranging from local communities to global society.

For most of our upper division courses, students are expected to demonstrate their ability to integrate knowledge gained from their earlier courses, including biology, chemistry, physics, and mathematics. Critical thinking is expected, and students should be able to show proficiency in analyzing data, researching a topic through the primary literature, and summarizing the information both verbally and in writing.

Several of our upper division courses (BIOL 311, BIOL 328, BIOL 340, BIOL 350, BIOL 390, BIOL 411, BIOL 430) require collaborative learning through either in-class discussion groups or collaborative research projects outside of regular class periods. For instance, BIOL 311, BIOL 390, and BIOL 430 require students to work in research groups that propose an original research project. These students submit a proposal, design an experiment, collect and analyze data, and present their results as part of a formal poster session. Many of these projects are presented at SCCUR.

Evidence

Courses	Course LO	PLO 1	PLO 2	PLO 3
BIOL 110 Colloquium for Freshman	1. display scientific literacy and an understanding of the scientific method through writing. 2. participate in active dialogue on the scientific method, and scientific ways to discovery. 3. display a basic understanding of both academic and research opportunities available at Pepperdine University.	I	I	I
BIOL 211 Biology of Cells	1. know and be able to explain basic cellular structure and cellular processes including growth, metabolism, reproduction, movement, and responses to internal and external signals. 2. understand the genetic basis of life, including the nature of genes, genetic inheritance, how genetic information is transcribed, translated and regulated and how genes and genomes change over time. 3. use statistical methods of data gathering, spreadsheets, and graphical analysis in scientific inquiry. 4. conduct student-initiated research projects, asking questions, developing hypothesis and controlled experiments, analyzing results using statistical methods, and presenting results in both written and oral formats.	I	D	I
BIOL 212 Biology of Animals	1. demonstrate an understanding of basic concepts in evolutionary biology, genetics, ecology, physiology, and reproductive biology as they relate to animal diversity. 2. comprehend various processes that both promote and erode worldwide biodiversity. 3. conduct primary research related to the understanding of biological processes.	1	D	I
BIOL 213 Biology of Plants	1. demonstrate the ability to apply the scientific method to problems in plant biology.	I	D	I

Does the degree offer sufficient breadth and depth of learning for this particular major or program? Please explain.

Both the B.A. and B.S. degrees in biology are comparable to degrees offered by not only our peer institutions but most universities in the United States. The courses required for completion of both these degrees equip students for varied careers in the life sciences. Many of our students are accepted into Ph.D. programs at major research one institutions, and now have academic positions. The admit rate to medical school for our biology graduates approximates 85%. Both of these metrics indicate that our degrees are more than sufficient for the major.
In particular, both the B.A. and B.S. degrees require biostatistics as well as a research methods laboratory, and in general, nearly all of the science courses taken by our students have a two to three hour laboratory component. Additionally, the B.S. degree requires students to take biochemistry. Both biostatistics and biochemistry are generally not required by many of the biology programs to which we compare our program.

Please present a curriculum comparison with at least three peer institutions and with national disciplinary or professional standards if available.

Curriculum comparison table

Comparison of Biology (B.S.) curriculum or equivalent program across peer institutions.

Institutions	Units Required for Degree	General Chemistry	Organic Chemistry	Physics	Math	Statistics	Upper Division	Lab Courses	Tenure-Track Faculty	Non-TT Faculty
Pepperdine University	21/69-72	4/8	4/8	2/8-10	3/8	2/4	11/36-37	14-15	8	1
Harvey Mudd College	37-39/74	4/5.5	3/7	4/8.5	6/9	1/1.5	16-18/36	7	8	2
Loyola Marymount University	26-27/73	4/8	4/8	2/8	2/6	0/0	8-9/27	12	15	2

Listed as number of courses/number of units

Comparison of Biology (B.A.) curriculum or equivalent program across peer institutions.

Institutions	Units Required for Degree	General Chemistry	Organic Chemistry	Physics	Math	Statistics	Upper Division	Lab Courses	Tenure-Track Faculty	Non-TT Faculty
Pepperdine University	20/57-58	4/8	1/4	2/8	3/8	2/4	9/24-25	10	8	1
Claremont McKenna College	22/88	2/8	2/8	2/8	1/4	0/0	6/24	11	14	10
Loyola Marymount University	22-23/63	4/8	1/3	0/0	2/6	0/0	8-9/27	8	15	2
Occidental College	15/80	1/4	1/4	0/0	2/8	0/0	4/16	9	12	10

Listed as number of courses/number of units

Degrees Offered

Degrees Offered	Pepperdine University	Claremont McKenna College	Harvey Mudd College	Loyola Marymount University	Occidental College
BS	Biology		Biology	Biology	
			Molecular Biology Option		
			Joint Major Chemistry/Biology		
			Math and Computational Biology		
BA	Biology	Biology		Biology	Biology
		Molecular Biology			Cell and Molecular Biology Emphasis
		Biochemistry			Marine Biology Emphasis
		Neuroscience			Environmental Concentration
		Environmental Analysis			
		Environment, Economics, and Politics			
		Organismal Biology Biophysics			

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We compared both the B.S. and B.A. degrees offered by the Biology Program at Pepperdine University to the following peer institutions (see attachment): 1) Claremont McKenna College, 2) Harvey Mudd College, 3) Loyola Marymount University, and 4) Occidental College (see attachment). Pepperdine offers both degrees, whereas Claremont McKenna College and Occidental College offer only a B.A. degree in biology and Harvey Mudd a B.S. degree. Overall, the Biology Program at Pepperdine University is comparable to its peer institutions in terms of courses required and units taken for both the B.S. and B.A. degrees in biology (see attachment). The B.S. degree at Pepperdine is similar to Harvey Mudd and Loyola Marymount in terms of the number of units required, but both peer institutions require more courses. Occidental College requires the least number of courses for the B.A. degree, whereas Pepperdine is similar to Claremont McKenna and Loyola Marymount. The number of units for Pepperdine, Claremont McKenna and Loyola Marymount and Occidental are similar.

There are some differences between Pepperdine's Biology Program and its peer institutions. Firstly, in contrast to Harvey Mudd and to a less extent Loyola Marymount, completion of the B.S. degree at Pepperdine requires more courses with labs. The number of lab courses for the B.A. are similar across all institutions. Secondly, Pepperdine's Biology Program does not offer emphasis areas, whereas the programs at Harvey Mudd, Claremont McKenna, and Occidental offer several different concentrations or emphasis areas. Thirdly, Pepperdine and Harvey Mudd have a similar number of tenured or tenure-track faculty and few adjuncts and visiting faculty. The other three institutions have considerably more tenured, tenure-track, and non-tenured adjuncts and visiting professors. Fourthly, the B.S. degree at Pepperdine is more similar to Harvey Mudd in that both degree programs require a course in statistics. Pepperdine appears to be the only program that requires one semester of biochemistry for the B.S. degree. We feel that current changes in the direction of biology require an early exposure to biochemistry as well as to molecular biology and the analysis of molecular and genetic data. Fifthly, we require separate courses in Animal Biology (BIOL 212) and Biology of Plants (BIOL 213), whereas most universities combine these courses. Finally, Pepperdine offers 14 upper division courses that can be taken as electives. With the exception of BIOL 328 (Environmental Policy and Politics), all of these courses have a laboratory requirement. None of these courses have the title Evolutionary Biology, but BIOL 430 (Population Biology and Conservation Genetics) is basically an evolutionary biology course. BIOL 212 (Animal Biology) and BIOL 311 (Ecology) also cover portions of evolutionary biology. In contrast, all of the peer institutions examined offer a wider range of upper division courses, and they have a specific course entitled Evolutionary Biology. Our Biology Program has a required freshman Colloquium in Biology, and students are provided an opportunity to write an honors thesis. In addition, BIOL 491 (Senior Seminar) approximates a capstone course. Harvey Mudd has a more extensive colloquium series, and a capstone project that results in a senior thesis.

Aside from Harvey Mudd, our Biology Program emphasizes early exposure to undergraduate research. The Natural Science Division and Biology Department provide opportunities for students to participate in research throughout the school year as well as during the summer. In addition, the laboratory component of all our biology courses for majors requires an independent research project that is designed and implemented by the student. Not only do students learn how to initiate a research project, they are also required to write a paper following a specific scientific format and to present their research through either posters or an oral presentation. Our basic philosophy is that training students for a career in biology requires direct involvement in the enterprise of scientific research.

In conclusion, comparison of our Biology Program to a broader array of peer institutions shows some similar patterns, with all B.S. degrees being similar in terms of the courses and units required. At the same time, our program is unique in terms of some requirements, such as laboratory courses, biochemistry, and statistics.

How current is the program curriculum?

The Biology Program curriculum is current and up to date. Each semester members of the faculty discuss the current curriculum and suggest changes and updates that are required. Textbooks are evaluated and lectures and labs are modified in accordance with new textbook information and pedagogical procedures. Laboratory maintenance occurs throughout the year, and Seaver College provides support for major equipment needs associated with laboratory research and teaching. In many cases, equipment purchases and upgrades allow us to stay abreast of on-going biological research, thus exposing students to laboratory procedures that most students do not experience until graduate school.
SLO #2 focuses upon the scientific method, experimental design, and the analysis of data sets. In our Genetics course (BIOL350) lecture material integrates the current research literature, problem solving, and engagement of at least one outside expert in the field per semester. The external expert typically offers a seminar, with students being prepped for the visit via readings and class dialogue. In the laboratory component of the course, students engage three major course projects; 1) gene mapping in *Drosophila melanogaster*, 2) use of gene silencing in *Ceanorhabditis elegans*, and 3) cloning genomic fragments from *Saccharomyces cerevisiae*, sequencing and analysis. Module #1 required a full laboratory write-up with presentation of project components and statistical analysis of the data generated. Modules 2 and 3 involve components of modern gene manipulation, experimental design, and analysis of data sets. The gene cloning and sequencing module is performed individually, ensuring independent competencies and accountability as students complete the laboratory component of this class. All reporting is assessed via rubric and results/scores retained for comparisons among each class. The balance of content from transmission genetics to molecular biology ensures student competencies in modern research techniques, and experimental approaches.

How has the curriculum changed (if at all) over the last five years including the reasons for the change (e.g., the result of a learning outcome assessment) and evidence used as a basis for change?

The Biology Program has initiated several changes over the last five years. Some of these changes relate to trends associated with retention and graduation, and others are the result of course and program assessments and student comments.
Seaver College runs an active study abroad program that targets students in the sophomore year. Many of these students participate in two semesters of study abroad, thus postponing completion of their core courses in biology. In an effort to address this problem, we now teach both BIOL 211 and BIOL 212 during the fall and spring semesters. This provides all of the biology majors with an opportunity to complete two of the three introductory courses.
Based on student input from surveys and discussions (see student survey and BIOL 110 report), we have modified BIOL 110 (Colloquium for Freshman Biology). In the past, each professor taught this course for two weeks and introduced students to various research topics in biology. This particular approach resulted in rather mixed comments from students. In 2013 members of the biology faculty reflected on student comments from evaluations and decided to change the basic format of the course. The new format allows for more field trips as well as hands-on research experience. In the fall of 2015 we organized students into research groups and had them collect data on a project of their choosing. Teams presented their results at a mini-symposium. In addition, students were divided into groups and allowed to visit the research labs of the biology faculty. During this period, individual members of the faculty as well as undergraduate research students explained their research. Some of the other additions included discussion group assignments pertaining to genetic determinism and faith and science. As can be seen from the student survey conducted at the end of the course, a majority of the students found the laboratory open house to be highly effective. Finally, several goals were achieved including: introduction of the freshman students to the biology major, development of a scholarly community of students and faculty, and provision of appropriate academic advising for the major.

Students in both BIOL 213 (Biology of Plants) and BIOL 311 (Ecology) conduct an independent research project that generally involves teams consisting of two to three students. The project requires a written proposal that includes a review of the primary literature and the hypothesis to be tested. In consultation with the professor, students develop an experimental protocol and collect data. They are required to analyze the data and give a formal oral and poster presentation on their research. A grading rubric (see attachment) is used to evaluate each student project. For the past few years, professors in both of these courses have used the same poster guidelines and grading rubric. The idea is to teach students how to conduct independent research and to present results in a professional manner. Preliminary analyses of these comparisons are interesting and suggest some modifications that need to be implemented. Firstly, we evaluated performance of the same students that took the courses in the preferred sequence (BIOL 213 and then BIOL 311). Secondly, we assessed improvement in students regardless of the sequence in which the classes were taken. Both comparisons failed to reveal any improvement on the effectiveness of research presentations. Based on these data, we are considering more coordination in the way we assess projects in these two courses. In particular, it would be best if each professor from these two courses independently graded proposals and poster presentations in both courses. Additionally, it is important to increase expectations of research quality in the more advanced course (BIOL 311). One major problem, however, relates to students taking these courses in sequence. Currently, students returning from study abroad do not take BIOL 213 until the spring of their junior year. Therefore, many take BIOL 311 before BIOL 213, which is sometimes taken by students the spring of their senior year.

Senior Seminar (BIOL 491) represents a course requiring mastery of PLOs 1 and 3. Professor Tom Vandergon implemented some very important changes to the course since the last five year review (see attachment). A combination of direct, indirect and authentic assessment protocols are being used to evaluate the degree to which students can think creatively, write about science, work collaboratively, present scientific information and lead discussions, and demonstrate a strong understanding about biological systems. One major change in the course is the implementation of case studies as a way to stimulate critical thinking and discussion on topics important to both biology and society at large. Grading rubrics are used to evaluate assignments, and at least two professors grade each assignment. Finally, students now participate in a service learning project that requires them to teach less informed middle school students. This new format for Senior Seminar has helped identify some strengths and weaknesses in both our curriculum and our students. Overall, students do not perform on the written assignments at the Capstone level, and in the future we have decided to change the course from credit/no credit to graded in an effort to encourage more enthusiasm for doing a good job. Other assignments, such as development of a resume, resulted in very good performance by the student, and student response in terms of the course helping them strengthen their views was positive. The results of the assessments in this course have stimulated considerable discussion about ways we can make changes to the biology curriculum in the near future, especially with respect to the introductory courses.

Introduction to Ecology (BIOL 311) is an upper division course required for all biology majors. The course is designed to assess mastery of program learning outcome 2. The basic format of the course involves less formal lecturing and more student interactions. We cover one chapter per week in the course, and students are asked to write a paper each week on a concept associated with the chapter. This paper must contain a documented example from the primary literature. Students form groups and present their concept paper to the group, and the student groups select the concept paper to be discussed in more detail. The third class period is used to cover in more detail important concepts not addressed by the student papers. Over the last five years, we have made some modifications to the way we assess student learning in this course (see attachment on assessment of BIOL 311). Firstly, we implemented a pretest to evaluate retention of information from the lower division courses, in particular BIOL 212 and BIOL 213. Surprising, students retain very little from their previous courses, suggesting that we need better coordination in terms of our expectations for students entering upper level courses. Secondly, in addition to the

pretest, we reevaluated student learning by embedding similar questions from the pretest in the first exam. Students showed marked improvement once the material was covered in class. Thirdly, we evaluated student performance on all exams by comparing level of mastery depending upon the way questions were asked. We were specifically interested in their ability to solve problems (presented as discussion questions) that required more synthesis and critical thinking. Students performed somewhat lower on these questions. Finally, student input was solicited midway through the course in an effort to gain insight from students about the learning environment and course format. As a result, we made some adjustments that included a more formal lecture on the third day of each week.

For a number of years, a few students in the Biology Program fail to meet the minimum grade point average for graduating with a major in biology. Part of this problem stems from students being allowed to take more advanced biology courses even though they have a minimal passing grade (D) in courses considered prerequisites. This year we modified requirements for enrollment in upper division biology courses. Students now need a C or better as a prerequisite for enrollment in upper division biology courses. Hopefully this will alleviate the problem of students staying in a major that is not suited to their particular interests and skills.

Pedagogy: Please present measures of teaching effectiveness (e.g., course evaluations, peer evaluations of teaching or implementing, scholarship on issues of teaching and learning, formative discussions of pedagogy among faculty, survey measures, participation rates, and student satisfaction surveys).

Teaching

Student Evaluations for Biology (Fall 2010 to Spring 2015)

	Enrollment	Respondents	Course GPA	Professor Score	Course Score
Mean	23.3	17.2	2.91	4.36	4.18
St. Deviation	13.4	9.8	0.36	0.48	0.40
Minimum (0%)	3.0	2.0	1.70	2.42	2.71
Quartile 1 (25%)	14.0	11.0	2.71	4.26	4.03
Median (50%)	20.0	15.0	2.87	4.49	4.29
Quartile 3 (75%)	30.0	23.0	3.14	4.66	4.44
Maximum (100%)	73.0	58.0	3.90	5.00	4.86

Student Evaluations for Natural Science Division (Fall 2010 to Spring 2015)

	Enrollment	Respondents	Course GPA	Professor Score	Course Score
Mean	21.2	16.3	2.96	4.32	4.16
St. Deviation	12.8	10.0	0.49	0.48	0.42
Minimum (0%)	1.0	0.0	0.00	0.00	0.00
Quartile 1 (25%)	13.0	9.0	2.70	4.08	3.97
Median (50%)	19.0	14.0	2.93	4.42	4.22
Quartile 3 (75%)	27.0	22.0	3.22	4.67	4.44
Maximum (100%)	141.0	106.0	4.90	5.00	4.94

The Biology Program implemented several different procedures designed to evaluate the overall effectiveness of our pedagogical methods. These included: discussions of pedagogy among faculty, course evaluations, survey of alumni, exit surveys of seniors, and participation in activities associated with teaching and student learning.

Discussions of pedagogy among faculty - Faculty members of the Biology Program have regular meetings to discuss all areas of our curriculum, including the assignment of specific teaching duties, coordination of laboratories, required prerequisites, and design of appropriate learning outcomes and their assessment. These discussions precipitated changes in the minimum grade in prerequisite courses necessary for enrollment in more advanced courses. Several other important changes and ideas for the future are the result of these discussions. For instance, we now have a more formal means of assessment in all of our courses, and similar rubrics are being used in most courses. Student input is being solicited via surveys and mid-semester evaluations. As a result we are discussing several future changes to the curriculum in the Biology Program. As mentioned earlier, we are considering making BIOL 491 a graded course, and perhaps a 2 rather than 1 unit course. We recently received a grant from the National Science Foundation that will fund a first year seminar program for incoming freshman biology majors. This course will allow students to become involved in original research at the beginning of their careers. Rather than BIOL 110, biology majors will be subdivided into four different first year seminars taught by senior professors in biology.

Based on our discussions, we will now allow students seeking a B.A. degree in biology to take biochemistry as one of their upper division electives. This should help with retention of students interested in medical careers.

Finally, we are initiating more cross-coordination between our lower division courses and upper division courses. For professors teaching introductory level biology courses, it would be helpful to know more about expectations for student preparedness prior to entering an upper division. For instance, students taking BIOL 350 (Genetics) should have a sound foundation in molecular biological concepts such as DNA replication, transcription, translation, meiosis, mitosis, and protein and gene structure.

Student course evaluations (see attachment) - Students are asked each semester to complete an online evaluation of each course and the professor teaching the course. The maximum score for these two categories is 5. Over the past five years, the average professor and course scores for biology were 4.36 and 4.18, respectively. The average GPA for all of these courses was 2.91. Overall, student evaluations for the Biology Program are very similar to those seen for all programs in the Natural Science Division.

Alumni Survey - The Office of Institutional Effectiveness conducted an alumni survey for all programs in the Natural Science Division (NASC). Results of this survey will be explained in another section.

Senior Survey (see attachment) - Each year, the Biology Program initiates a survey of graduating seniors. This is conducted as part of the Senior Seminar (BIOL 491). On a scale of 0 to 5, students were asked to rank the effectiveness of 8 components of the biology curriculum. The program was ranked close to 4.5 for effectiveness in categories pertaining to evolution, analysis, scientific method, and lab and field experiences. The effectiveness of providing access to research activities and fostering an understanding of ethical issues in biology was also ranked above 4.0. The two areas ranked lower, which is consistent with the alumni survey, are preparation for postgraduate careers in biology and emphasis of a sense of vocation that integrates faith and training as to how one can utilize a vocation in biology in broader service to society. At the same time, 70% of students felt that the theory of evolution was well integrated with their particular belief system.

Students consider courses in biology to be rigorous, and over 80% of students felt the biology major enriched their interest and enthusiasm for science. A large majority of students recommended that the Biology Program should offer more course options, especially upper division electives. Over 80% of students also felt that exposure to research opportunities was foundational for their development.

Peer Evaluation of Teaching - All members of the faculty in the Natural Science Division submit an annual report that outlines their research and teaching activities. These evaluations are examined by the Divisional Dean, and a formal account of the professor's report and an assessment of student evaluations are provided. This allows for a dialogue about current teaching activities and future goals. Pre-tenured members of the faculty receive feedback from more senior faculty, and there is a major mid-tenure assessment involving internal peer reviews and evaluation by the Rank, Tenure, and Promotion (RTP) Committee. In addition, all tenured members of the faculty are evaluated every five years by the RTP Committee, and teaching effectiveness receives considerable scrutiny. In particular, all reviews of faculty place a high emphasis on teaching effectiveness, and as such, members of the faculty are required to provide detailed information about their teaching methods. They also are asked to provide a self-evaluation of ideas they have for improving pedagogy.
Activities Associated with Teaching and Learning - Several of our faculty in biology attend meetings of the Association of American Colleges and Universities. Many of the workshops and presentations and these meetings focus on pedagogy. In addition, at least half of the biology professors are members of the Council on Undergraduate Research. Our faculty and students also participate in professional organizations that emphasize undergraduate research, and each year a large number of our majors participate in SCCUR.

Biology Senior Survey Data

Please rank the effectiveness of your biology curriculum with regard to each of the following goals we have for you in our program.

1. Vocation - emphasize that a sense of vocation requires an integration of faith and training in a particular field of endeavor as well as the utilization of that vocation for a life of service.

2. Evolution and Natural Selection - explain the foundational concept of evolution by natural selection through detailed studies of comparative anatomy, paleontology, cytology, genetics, molecular biology, and ecology.

3. Analysis - teach critical thinking and the application of the scientific method in biological research.

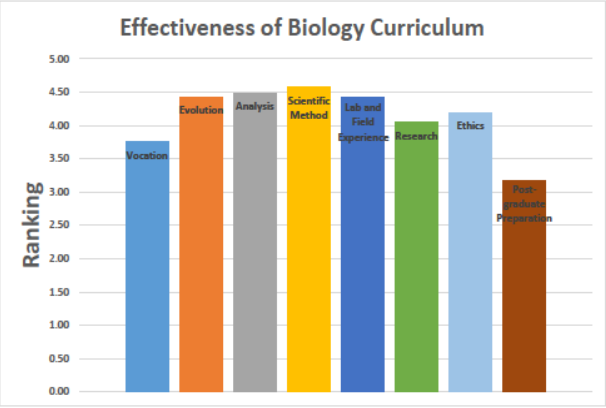
4. Scientific Method - provide training in the enterprise of science, including the design of a research project, the implementation of a detailed literature search on a topic of research, the analysis and interpretation of scientific data, and the presentation of research in both written and verbal formats.

5. Lab and Field Experience - develop first-hand knowledge of experimental techniques for both laboratory and field research.

6. Undergraduate Research - provide access to undergraduate research activities under the direction of members of the biology faculty, including independent research or an honors thesis.

7. Extended Dimensions of Science - foster an understanding of ethical issues in biology related to human genetics, environmental policy, biomedical treatments, and research design.

8. Postgraduate Preparation - make students aware of the diverse career opportunities in the biological sciences and provide guidance on how to successfully compete for advanced training in biology after graduation.



ANALYSIS OF EVIDENCE: Quality

Quality

Quality of the Degree: In meaning of the degree student learning outcomes and curriculum matrixes were used to
define the degree. Now please describe the processes used to ensure the quality of the program.

Describe the high impact practices which enrich the learning experiences (How are they integrated in the curriculum? Are they assessed?)
a. Service learning
b. Research opportunities
c. Internships
d. High-impact practices

High Impact Practices - For over 20 years, the Biology Program has received extramural funding from the National Science Foundation (NSF) for our program entitled, Summer Undergraduate Research in Biology (SURB). Each January, students majoring in biology at Pepperdine are introduced to the SURB program, and applications are received online. Students are required to write an essay as well as to provide appropriate references. Off-campus students apply through an online application service. A cohort of 8 students is recruited through the NSF program, and supplemental funding through private donations and Pepperdine allow recruitment of approximately 4 additional students. This program involves exposure to original research. In addition, students receive training in proposal writing, oral presentation, collection and analysis of data, development of a poster, scientific ethics, and career opportunities. Professors from other universities are invited to interact with students in the SURB program, thus providing broader exposure to the profession. At the end of each summer program, students participate in a symposium that includes students and faculty at Pepperdine as well as the broader community in the Los Angeles area. Assessment protocols adhere to NSF guidelines and provide a pre-evaluation during the first week as well as an exit evaluation. A separate evaluation is provided by each professor, who comments on development of students under their mentorship.

The SURB program has proven to be highly effective at fostering interest in careers in biology. Many of the former students in this program now have academic appointments, and a large number have either recently received Ph.D. degrees or are currently in a Ph.D. program. SURB students routinely present their research at regional and national meetings, and several have won presentation awards at these meetings.

In addition to SURB, the Natural Science Division provides support for other students interested in summer research. These funds (average of $51,340 over past 5 years) help increase the overall support for our students interested in intensive summer research. Overall, the summer research opportunities allow our students to gain the expertise and data necessary for completion of an honors thesis.

Other Research Opportunities - The honors degree in biology is a research degree. Nearly all members of the biology faculty have sponsored an honors student, and this is the result of students being able to continue research throughout the school year as well as the summer. Some of these students are research assistants, and others are supported from extramural funds. This support funds an average of 8 to 16 students during the school year. Seaver College also provides several funding sources that support undergraduate research. In many ways, exposure to research in our courses provides the initial stimulus for students to seek further training outside of class.

Service Learning - As indicated earlier, BIOL 491 (Senior Seminar) now has a service learning component. Biology majors are required to communicate various concepts in biology to students at a local middle school. In addition, SURB students participate in a service project that involves students from a local charter school in Central Los Angeles.

Co-Curricular : How intentional are the co-curricular experiences which are provided and how are they integrated into the curricular plan?

Co-Curricular experiences are well integrated with the Biology Program. All incoming first year and transfer students receive a detailed orientation the week prior to classes. As part of this orientation, members of the biology faculty help these students with their class schedules and assist in formulating a degree plan that accommodates absence during their sophomore year as part of the study abroad program.

The First Year Seminar is designed to help beginning students transition into college. Classes are small (14-17 students) and involve close interaction with their instructor. Aside from work on a particular topic, students are introduced to many services such as the library, the counselling center, and the career center. Many of our biology faculty teach or have taught a First Year Seminar, designed to introduce students, majors and non-majors, to scientific concepts. Two seminars that we teach are Scientific Decision Making, which focuses on the evaluation of information with the scientific method, and Plants and the Environment.

Each biology student is assigned an academic advisor from the biology faculty. This advisor helps the student develop a four year plan that allows for transition from lower to upper division courses.

Financial support for biology students as well as other majors is provided throughout the school year. On average, the Natural Science Division receives $72,000 per year for student salaries. This support funds student teaching and research assistants as well as student tutors. Aside from a financial reward, students benefit in two other ways as a result of this support. Firstly, being a either a teaching assistant or a tutor provides a learning experience for the student teacher as well as the student being taught. Secondly, it enhances retention of biological information on the part of the student teacher or tutor. At the same time, student teachers may provide a more understandable explanation of a concept than that provided by the professor.

The Natural Science Division receives between $130,000 and $150,000 for student scholarships that are awarded at the beginning of each fiscal year. Students apply for these scholarships, and Program Coordinators and the Divisional Dean evaluate each application. Awards are based on academic achievement in the major as well as the overall coursework. The Natural Science Division also receives scholarship funds from several non-profit institutions, and these awards are made using the same criteria as those outlined for the divisional scholarships.

Seaver College has a Career Center that provides students with advice on development of resumes, and a Student Employment Center that coordinates all sources of student employment through the university. The university sponsors career fairs where students are introduced to potential employers. The Natural Science Division provides some support for students to attend professional meetings, and many of the biology majors take advantage of this support. This exposure helps with networking, which is important for students interested in graduate school. Biology students are encouraged to submit proposals for both Fulbright and NSF predoctoral fellowships, and members of the biology faculty mentor students with respect to proposal writing.

Pepperdine provides a host of other co-curricular activities. Project Serve allows students to

actively engage the local community by providing a number of services, and the student government supports a number of events as a way of engaging the campus community. There are several multicultural opportunities on campus including: 1) Loqui hosts events that celebrate diversity and inclusiveness. 2) The Intercultural Affairs office attempts to enhance cross-cultural understanding. This office initiates a number of events throughout the year. Students are able to be involved in extracurricular activities such as plays produced by the Fine Arts Division and student inspired musicals (Dance in Flight and Songfest). 3) The Well is a new weekly event that embraces the entire faith community through music and praise. The Seaver Dean's lecture series invites a diverse array of well-known speakers, who interact with students, faculty and the local community. Students and faculty in biology actively attend this lecture series.

Seaver College has an extensive study abroad program that offers sophomores an opportunity to complete a large number of GE courses while living in a host country. In addition, International Programs provides support for a number of summer study abroad opportunities. Members of the faculty in biology participate in both the year-long and summer programs. Over the past years, the biology program organized summer courses in Argentina, Costa Rica, Ecuador, and Africa. For sophomores, who do not participate in the study abroad program, the President's office supports the Sophomore Experience. This program is designed to create a sense of community for students not participating in study abroad. Each year, these students take educational trips to San Francisco, Santa Catalina Island, and other regions. Members of our biology faculty participate in this program.

Seaver College provides a number of different programs that promote the emotional and spiritual well-being of students. We have a very active Counselling Center as well as a Testing Center for students with special needs. All members of the faculty are encouraged to identify students needing help, and there is a well-defined network for assisting these students. Convo is a mandatory requirement for all students, and the main priority of this program is to encourage spiritual development.

What is the profile of students in the program and how does the profile relate to or enhance the purpose and goals of the program?

Student Success Data

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BA in Biology an BS in Biology First-time Freshmen 4-Year and 6-Year Graduation Rates

BA in Biology	Cohort	4-Year Graduation Rates	6-Year Graduation Rates
Fall 2005	5	80.0 %	80.0 %
Fall 2006	7	42.9 %	42.9 %
Fall 2007	7	42.9 %	71.4 %
Fall 2008	4	75.0 %	75.0 %
Fall 2009	13	61.5 %	69.2 %
Fall 2010	7	57.1 %	
Fall 2011	11	90.9 %	

BS in Biology	Cohort	4-Year Graduation Rates	6-Year Graduation Rates
Fall 2005	31	74.2 %	83.9 %

Fall 2006	25	80.0 %	84.0 %
Fall 2007	23	65.2 %	73.9 %
Fall 2008	47	78.7 %	87.2 %
Fall 2009	66	77.3 %	87.9 %
Fall 2010	56	82.1 %	
Fall 2011	42	78.6 %	

BA and BS in Biology	Cohort	4-Year Graduation Rates	6-Year Graduation Rates
Fall 2005	36	75.0 %	83.3 %
Fall 2006	32	71.9 %	75.0 %
Fall 2007	30	60.0 %	73.3 %
Fall 2008	51	78.4 %	86.3 %
Fall 2009	79	74.7 %	84.8 %
Fall 2010	63	79.4 %	
Fall 2011	53	81.1 %	

The average student enrollment in biology, as estimated in fall semester for 2010 to 2014, is 144, with approximately 20% of students enrolling in the B.A. program. In terms of enrollment, the number of women averages 61% for the past five years, and ethnic minorities (Hispanic, African American, and Pacific Islander) represent approximately 23% of the total enrollment. There is an overall trend of increased enrollment of ethnic minorities (both African American and Hispanic) over the last three years. Approximately 15% of the entering class over the last five years represents first-generation students. As a faith-based school, Pepperdine University has a connection with the Churches of Christ, yet enrollment of students indicating an affiliation with this faith community shows a decline by 50% over the last three years.

Student recruitment focuses primarily on predictors of academic success, such as either SAT or ACT scores and high school GPA. The average SAT scores for students entering the Biology Program since 2010 are 628 for verbal and 645 for mathematics. Overall, these scores are consistent throughout this period, whereas the high school GPA shows a slight decrease since 2011.

The estimated one year retention rate between 2010 and 2014 averages 93%. Retention appears to be somewhat lower (84.8%) for first generation students. At the same time, the average rate of retention of minority students approximates that seen for all students. In fact, the retention rate is 100% for African American students.

The four year graduate rate between 2005 and 2011 is 75.6% for the BA and BS in biology combined, with the rate increasing to 82% for students graduating in six years.

15. Please present your student and alumni survey data examining student attitudes, satisfaction levels and dispositions. OIE will provide the data in tables and graphs in their Educational Effectiveness Report. Programs are responsible for explaining the survey results. Survey data includes: UCLA/CIRP satisfaction survey data, alumni data.

Student Survey Data

The survey was sent to 1,562 NASC alumni, with 411 responding (26% response rate). The Biology Program received the highest response rate at 40.3%, and response by gender was

nearly identical. Full-time employment was reported for 69.1% of the respondents, and 17.3% were currently in graduate/professional school. Several program related questions, based on a scale of 1 (strongly disagree) to 5 (strongly agree) were asked of the alumni. Here are a few of the responses: 1) My lab science course taught me critical thinking as it pertains to the scientific method - 69.8% strongly agreed. 2) I received a well-balanced introduction to the Natural Science Discipline - 70.8% strongly agreed. 3) Based on a scale of 1 (very poor) to 4 (very good) - 61.8% thought the senior capstone course was very good. 4) Some questions related to numerical and quantitative analyses as well as preparation for appropriate use of the library were in the mid-40%, suggesting the need for improvement in this area. 5) 88.2% of the respondents felt that the educational resources were adequate. 6) Although respondents indicated a reasonably good approval rating for personal development (68.2%), they considered professional development considerably lower. 7) Overall, the major of respondents felt that the program met their expectations extremely well (63.6%). We are now using this survey information to carefully consider how we can address some of the areas where responses indicated a need for change.

Please describe evidence of students' research and publications, awards and recognition, professional accomplishments.

Evidence of Biology Student Scholarship

Presentations at Scientific Meetings (undergraduate identified with *)

Aquirre*, N.M., S.B. Nelson*, A.N. Davis*, and S.D. Davis. 2015. Root hydraulic conductance in *Malosma laurina* experiencing severe dieback in the Santa Monica Mountains. Southern California Conferences for Undergraduate Research. OS-1-10:00.

Alvarado*, S. and J. Brewster. 2012. Ultrafine Particulates Differentially Induce Reactive Oxygen Species in Fibroblast BHK21 and A549 Human Alveolar Lung Cells. Southern California Conferences for Undergraduate Research. Abstract PSI-31.

Buie*, J., N. Huron*, E. Uemura*, and L. Kats. 2011. Effects of chemical cures from California newts (*Taricha torosa*) on an invasive species (*Procambarus clarkia*). Southern California Conferences for Undergraduate Research. Abstract PSI-11.

Burns*, A.M., H.L. Holmlund*, V.M. Lekson*, and S.D. Davis. 2014. Novel seed germination in *Ceanothus* chaparral without a fire-cure, caused by California's historic drought. Science Day Symposium, sponsored by the National Park Service and Southern California Research Learning Center, 9 September 2014

Burns*, A.M., N.A. Nakamatsu*, V.M. Lekson*, H.I. Holmlund*, and S.D. Davis. 2015. Novel seed germination in response to California's historic drought may deplete soil seed banks. 100th Annual Meeting Ecological Society of America. PS77-172.

Candelore*, T. and J. Brewster. 2011. The effect of ER stress on GAPDH nitrosylation and translocation. Southern California Conferences for Undergraduate Research. Abstract OSI-10.

Carrington* A., L. Knight*, A. French*, R. Barker*, and S.D. Davis. 2013. The effect of dirt accumulation on light absorption in the banana leaf (*Musa* sp.). Southern California Conferences for Undergraduate Research. Abstract PSI-23.

Carter, A.* and Karen Martin. 2011. Maternal investment in a short-lived, iteroparous marine fish. Society for Integrative and Comparative Biology Conference in Charleston, SC.

Chin*, J., D. Land* and J. Jasperse. 2012. Mechanisms causing myogenic and reactive dilation in rat soleus feed arteries. Southern California Conferences for Undergraduate Research. Abstract PSII-131.

Chin* J.J., S.R. Jasperse*, and J.L. Jasperse. 2013. Endothelial contributions to myogenic and reactive dilation. Southern California Conferences for Undergraduate Research. Abstract PS2-58.

1

Between 2010 and 2015, biology students in our courses, summer research programs, and honors program presented 121 posters/oral talks at local, regional, and national meetings. In addition, they were authors on 12 peer-reviewed publications. Eight students completed honors theses, and 3 students received Fulbright Research Scholarships. In addition, several of our students in Ph.D. programs received pre-doctoral fellowships from the National Science Foundation. There is an approximately 85% admission rate for biology students applying to

medical school, and all of our biology students that applied to veterinary school were admitted.

ANALYSIS OF EVIDENCE:Integrity

Are the graduates achieving the student learning outcomes at the expected level? How was the threshold determined? How do you know your expectations are appropriate? Do you use comparisons based on national standards or benchmarking? How have your assessment findings supported this?

Unlike some majors in science and mathematics, there is no national accrediting body for biology. Based on the 2007 study by Cheesman et al. (BioScience 57:516-522), there is a common core to which most colleges and universities adhere. Core requirements outside the biology major include general chemistry, organic chemistry, physics, calculus, and sometimes statistics. Within the major, over 90% of institutions of higher learning surveyed require genetics, microbiology, ecology, cell biology, and physiology. Between 1990 and 2005, biology programs requiring research and statistics increased by 163% and 169%, respectively. Most of these trends and curriculum recommendations are similar to those recommended by the National Research Council (NRC) in their report entitled, "Transforming Undergraduate Education for Future Research Biologists." At the same time, the NRC suggested that based on current trends, many traditional courses need to be revised. Cheesman et al. (2007) also evaluated course content prescribed by biology programs. Over 90% of these programs emphasize the scientific method, biochemistry, cell biology, metabolism, photosynthesis, molecular genetics, transmission genetics, evolution, ecology, animal biology, and biodiversity.

Clearly, a majority of biology programs adhere to a common set of core curriculum and course content. As indicated by Project 2016 presented by the American Association for the Advancement of Science (AAAS), there are benchmarks for scientific literacy in biology as well as other scientific disciplines. The Biology Program's three program learning outcomes provide benchmarks similar to the ones proposed by AAAS. PLO 1 emphasizes a conceptual understanding of basic biological principles and processes (origin and diversity of life, functional units of life, relationships among biological systems, structural and functional components of life, information transfer of life). Mastery requires more than a demonstration to memorize facts. PLO 2 pertains to scientific investigation of biological phenomena, and this requires a more synthetic approach. It is true that biology requires some foundational knowledge, but the goal of the PLO is to train students how to ask questions about living systems and to find answers to those questions through rigorous scientific inquiry. Finally, PLO 3 is about application and integration of knowledge gained from the discipline. This requires the ability to think of one's discipline in a broader context. Additionally, students are expected to display the ability to accurately and effectively communicate about science to a broader audience.

Most of our courses assess student learning through the evaluation of direct and indirect evidence, and some of the upper division courses use authentic evidence. Another measure of the effectiveness of the Biology Program can be obtained by comparing MCAT scores for our biology majors to those of students from institutions across the United States. The rankings for the portion of the exam related to biological science are as follows: 1) 2011/2012 - 83.7%; 2) 2012/2013 - 66.9%; 3) 2013/2014 - 70.2%; 4) 2014/2015 - 60.5%; 2015/2016 - 78.1%. Based on the overall admit rate for our majors that apply to medical school, these rankings suggest that our students are learning at the appropriate level.
Based on our assessments of lower and upper division courses, our students do show improvement as they advance from the lower division courses and core courses from outside the

major. In our upper division courses, students demonstrate marked improvement in all three categories outlined in our PLOs.

Is there assurance that students consistently meet the standards of performance that the major has established? What happens to students that don't meet the standards?

This is a problem area for two reasons. Firstly, a small number of students do not meet the standards level of performance, and this becomes apparent in our lower division courses. This is one reason why a C- or better is now required for advancement to upper division courses. Professors attempt to counsel these students because it is better to seek another major early in the student's academic career. Secondly, there is no need for premed students to major in biology, but they must take several courses in the biology curriculum. This can create problems in the upper division courses such as BIOL 350 (Genetics) because the course requires baseline knowledge of cell and molecular biology, which is a prerequisite. Nevertheless, students without this background may fall below the basic standards. This is why we have BIOL 211 as a prerequisite.

19. Please present an integrated analysis of the data collected from the assessment of direct learning and indirect learning (survey data, focus group, alumni data, and authentic evidence). Please report on the findings from the last comprehensive program review. In summary please explain how the program has achieved a holistic evaluation of the students' educational experience.

Evidence

Biology_Senior_Survey_Data.pdf
Assessment_for_BIOL_328.pdf
Assessment_for_BIOL_450.pdf
Assessment_for_BIOL_460.pdf
Assessment_for_Biology_211.pdf
Assessment_for_Biology_212.pdf
Assessment_for_Biology_311_for_2011_and_2012.pdf
Assessment_for_Biology_340.pdf
Assessment_for_Biology_350.pdf
Assessment_for_Biology_470.pdf
Assessment_for_Biology_491_2015.pdf
Assessment_of_BIOL_411.pdf
BIOL_212_Syllabus_Honeycutt_Fall_2015.pdf
BIOL211_01_Nofziger_Plank.pdf
BIOL350_Brewster.pdf
BIOL411Syllabus_2013_.pdf
BIOL450_01_Martin.pdf
BIOL460_01_Nofziger_Plank.pdf
BIOL470_Vandergon.pdf
Biology_311_Syllabus_2014.pdf

Direct Evidence: All courses in biology are assessed based on direct evidence, and the type of evidence varies across courses. The format of these direct assessments varies. BIOL 211 uses answers to specific questions related to key concepts. From the overall distribution of scores on the third mid-term exam and final exam, there is generally a normal distribution of student learning outcomes. Approximately two-thirds of students pass these exams with a "C" or better with the other third having lower performance. Based on these two semesters, only 8% of students failed the final exam. For an introductory course and as the first major's biology course for many students, this outcome is satisfactory for the biology program. A majority of students do show introductory skills (PLO 1) for Biology 211 SLOs 1 and 2.

BIOL 212, BIOL 311, BIOL 328, and BIOL 470 look at both raw exam scores as well as performance on questions requiring either memorization or synthesis. Average scores for BIOL 212 across three exams and the final were 75%, 77%, 73%, and 72%. For BIOL 311, The overall averages for Exam I, Exam II, and the Final were 79%, 79%, and 74% (66%, 77%, and 74% for 2011/2012), respectively. On the final, the average score for old material covered was 69% and 78% for new material. These scores are in line with our expectations of an average of 70% for these two courses, but the lower score on the BIOL 311 final suggests a lack of retention of concepts discussed throughout the semester.

BIOL 311, BIOL 350, and BIOL 460 also look at performance across several categories of test questions (multiple choice, fill in the blank, short answer, and discussion). In all of these courses, students tend to score lower on questions that are either quantitative or synthetic in nature. Clearly, they do much better on questions requiring memorization.

BIOL 211 and BIOL 311 compare scores from pre-tests to tests taken after exposure to specific topics, and increase in performance is evaluated by examining answers to similar questions throughout the course. Evidence from both of these courses scores below expectations, but subsequent to coverage in the course, students showed marked improvement. The assessment of the pre-test in BIOL 311 is somewhat problematic because students scored in the 40 percentile, considerably lower than the expected value of 65%.

BIOL 328 (Environmental Policy and Politics) is unique in that it has majors in both political science and biology. Therefore, one concern was that students in political science might be less able to grasp scientific concepts, whereas the political issues might be hard for the biology majors. The average grades for biology students (avg. grade = 85) and political science students (avg. grade = 87) were very similar. In addition, we were concerned that the lengthy essay format might cause students to perform poorly on the midterm versus the final exam. In fact, the midterm average of 84 was slightly higher than the final average of 82.

Indirect Evidence: Indirect evidence of student performance generally employs either solicitation of input from students or comparison of performance relative to prior training. For instance, BIOL 212 and BIOL 311 ask students to provide input at mid-semester. In BIOL 311 students are asked the following questions:
1) Do you feel that there is a connection between the content (e.g., course information), delivery (e.g., instruction), and assessment (e.g., exams and assignments)? Please explain.
2) Comment on what I can do to facilitate your learning and performance in this course. Be very specific.
3) What elements of the class have you enjoyed so far (class format, organization of the material, discussion, lecture, close reading of texts, pair and share)?
Based on student input, professors in both courses made adjustments.

Student performance on a pre-test given the first week of classes in BIOL 211 was compared to student scores on the Biology Advanced Placement exam. Interestingly, it appears as if students

completing AP biology have a slightly higher performance on the pre-test compared to students not having AP biology; however, the performance level for both groups is well below a passing grade in the course.
BIOL 328 involves student participation in the form of evaluating student presentations on an original research project. Both students and faculty use a grading rubric to score presentations and to provide feedback on the overall quality of the presentation. Our results showed a strong correlation between both groups of graders.
Authentic Evidence: Several courses use authentic evidence as part of the assessment process. BIOL 211 requires application of knowledge through the development of a research proposal and research presentations. In addition, students are required to demonstrate expertise in experimental design and statistics. Generally, students exceed minimum expectations and show improvement on subsequent assignments.
BIOL 328 (Environmental Policy and Politics) uses two forms of authentic evidence. Firstly, field trips and guest speakers are used to expose students to environmental problems in the greater Los Angeles area. The guest speakers include environmental lawyers, religion professors, developers, conservationists, philosophy professors, and professors interested in environmental writing. Students are required to participate in discussions with these individuals. Secondly, each student is required to write an original research paper on an existing environmental problem. This paper must consider the scientific, political, economic, and social implications of the problem, and an informed recommendation should be provided.
These are just a few examples of our various approaches to assessment of student learning. One general trend observed throughout the assessment of our courses is that students perform above the minimum expected criterion for upper division courses. This suggests an increase in maturity as well as ability. Assessments in BIOL 491 (Senior Seminar) clearly indicate an increase in student ability to critically evaluate a problem and to communicate biology in a broader context.
Senior Survey and Alumni Data: We previously discussed these two forms of assessment. In general, both our seniors and alumni feel that the biology curriculum prepared them for careers in their discipline. Students consider courses in biology to be rigorous, and over 80% of students felt the biology major enriched their interest and enthusiasm for science. A large majority of students recommended that the Biology Program should offer more course options, especially upper division electives. Over 80% of students also felt that exposure to research opportunities was foundational for their development. Overall, the major of respondents from our alumni survey felt that the program met their expectations extremely well (63.6%).

WASC 5 CORE COMPETENCIES

WASC 5 CORE COMPETENCIES

How does the program ensure that graduates meet the WASC FIVE CORE COMPETENCIES? Present your findings of measurements you have done of the core competencies (may be less than 5).

As indicated in question 19, the Biology Program addresses all five of the core competencies. Information literacy is expected in all of our courses, and this is measured by overall performance on exams. In particular, we evaluate how well students retain such information through pre- and post-tests as well as directed assessment of knowledge of content. Based on our course assessments, students exceed our minimum expectations.
Like all science courses, critical thinking and quantitative skills are requisite for anyone majoring in biology. The independent research projects and in-class laboratory experiments are designed to teach students to ask questions and to design experiments that provide answers. Such an approach is part of the scientific method. Moreover, students must use statistical analyses to test

hypotheses, and this is a quantitative exercise. As previously indicated in our assessments, our students show increased maturity to think critically, and their ability to evaluate information from a quantitative perspective definitely improves as they advance to senior-level courses. One good metric is the number of research projects that our students present at scientific meetings, where they must defend their results in a logical and convincing manner.
Nearly all of our courses are designed to enhance written and oral communication. Students are taught to use the primary literature, write research proposals, maintain detailed laboratory workbooks, organize poster presentations, and orally present their research and ideas to their peers. All of these activities are evaluated with appropriate rubrics..

SUSTAINABILITY: RESOURCES

Sustainability

21. With the rapid changes in the higher education environment, the University needs to demonstrate how financial viability and planning of their long-term stability are ensured.

In order to demonstrate this each program should address
a. questions about the level of student demand for the program and
b. the degree to which resources are allocated appropriately so they are sufficient to maintain program quality.
c. What is happening within the profession, local community, or society that identifies an anticipated need
for this program in the future? (If appropriate include market research.)

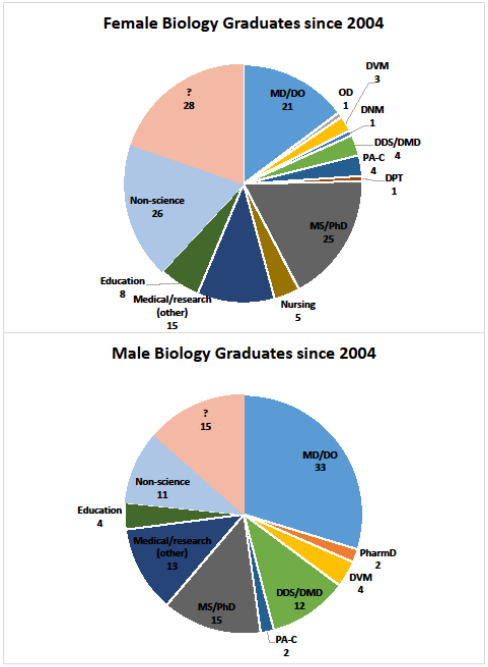
Over the past five years, the number of students enrolled in the Natural Science Division has averaged 557 students, and an average of 307 (55%) students major in STEM-related disciplines (e.g., Biology, Chemistry, Computer Science, Mathematics, Physics, and 3/2 Engineering). Over these five years, an average of 29% of students in the Natural Science Division major in biology. Therefore, there appears to be plenty of demand for the major.

Although the demand is increasing, Seaver College provides the resources necessary for the maintenance of a quality Biology Program. Support for teaching and research assistants has increased. We receive support for major equipment each year. Students receive some support for travel to scientific meetings. We receive scholarship funding for our majors. Our program continues to be successful at procuring extramural support for both our research and teaching mission. This enhances our summer undergraduate research program.

As noted by multiple surveys and publications, there is a push to train more students in STEM-related (Science, Technology, Engineering, and Math) disciplines. As such, enrollment in STEM-disciplines at Pepperdine University and across the United States is increasing, and the Biology Program is an integral component of majors offered in STEM-disciplines.
The majority of our majors, both men and women, obtain either advanced training in a biology-related field or work in areas requiring a degree in science. We recently surveyed our biology graduates between the years 2004 to 2015 and asked them to indicate how they were using their degree. The following methods were employed: 1) Categories such as "MD" indicate that graduates are either pursuing or have already completed a MD degree. Categories include recent graduates whose future plans fall in that field. 2) If graduates changed categories (e.g. MS to MD), they were placed in their most recent/current field. 3) If graduates received a graduate degree and started their own company, they were placed in the category of the graduate degree. 4) If graduates have a current job, they were placed in that job's category (usually

medical/research other) instead of their future plans. 5) MLS degree = medical/research or other. 5) The question mark indicates that no response was received. We have data for 142 female graduates and 111 male graduates.
As can be seen in the following graphs, a large portion of our graduates are using their degree. Therefore, this is an excellent indicator that there is a demand for students trained in biology.

Alumni Data



FACILITIES

The Natural Science Division at Seaver College is housed in two main areas, the first to fourth floors of the Keck Science Center (KSC) and the first floor of the Rockwell Academic Center (RAC). The total space allocated to the division is 39,037.5 ft2, and square footage within this space includes offices for faculty and staff, storage areas, support facilities, research and teaching laboratories, and classrooms. There is no immediate space allocated specifically for studying by students, but students are allowed access to empty classrooms during the day as well as the RAC lobby, which is decorated with adequate furnishings. In addition, students are in easy walking distance to the Payson Library.

Of the space allocated to the Natural Science Division, 943 ft2 is used for the main office, stockroom, and tech support. In addition, there is approximately 1,401 ft2 that includes space for office equipment, a break room, adjunct office space, a conference room, and the lobby. Storage space consist of 1,159 ft2. In addition, approximately 1,751 ft2 is used for a vivarium, autoclaves, the stockroom, a cold room, chemical storage, and washroom.

Classrooms for all courses taught by programs in the division are scheduled by the Office

Administrator of the Natural Science Division. Currently, the division has access to 9,801.5 ft2 that is used as classroom space, with classrooms distributed throughout the RAC, KSC, CAC (Cultural Arts Center), and the Plaza. In addition, PLC102, a classroom adjacent to the Payson Library, is used to teach several classes in mathematics. The following is a list of classrooms by student capacity: 1) 50 students: Plaza 188 and KSC 130; 2) 30 students: CAC 124, CAC 125, and RAC 175; 3) 24 students: KSC 100, KSC 110, RAC 170; 4) 16-22 students: KSC 210, KSC 300, KSC 320, KSC 360, RAC 138, RAC 178. Four (KSC 210, KSC 300, KSC 320, KSC 360) of these classrooms are used as teaching laboratories as well as classrooms.

Faculty members have assigned lab space that is used for both research and teaching. Programs using most of the laboratory space include Biology, Chemistry, Physics, and Sports Medicine. Collectively, this amounts to approximately 9,788 ft2. Laboratory space utilized primarily for teaching includes 14,956 ft2. Office space for faculty is located in the RAC and totals 4,240 ft2. In addition, there are two offices in the PLC for one visiting professor in mathematics and the Coordinator of Nutrition's post-baccalaureate program for students interested in becoming Registered Dietitians.

The Biology program in the Natural Science Division has seven full-time faculty with offices in the RAC. The amount of office space allocated to these faculty members is 800 ft2. Each member of the biology faculty has a lab that is used for both personal research and undergraduate teaching. Direct laboratory space amounts to 2,853 ft2, with an additional 149 ft2 allocated for equipment used by all faculty. Extra support for research and teaching in biology includes access to chemical supplies, a stockroom, two autoclave rooms, a washroom, vivarium, and storage space. Approximately 6,466 ft2 of space is used for classes requiring a lab. Teaching lab space used exclusively by biology includes 4,034 ft2, with another 1,708 ft2 shared between biology and sports medicine.

FACULTY AND STAFF

What are the qualifications and achievements of the faculty/staff in the program in relation to the program purpose and goals? How do faculty/staff members' backgrounds, expertise, research, and other professional work contribute to the quality of the program

The Department of Biology has eight full-time members of the faculty, six men and two women, and in terms of ethnicity, seven are Anglo and one Hispanic. Currently, all members of the biology faculty are tenured or tenure-track and have terminal degrees. The list of faculty and their specific rank are as follows: Dr. Jay Brewster (Professor), Dr. Stephen Davis (Distinguished Professor of Biology), Dr. Rodney Honeycutt (University Professor), Dr. Lee Kats (Professor Biology, Frank R. Seaver Chair of Biology and Associate Provost for Research), Dr. Karen L. Martin (Professor and Frank R. Seaver Chair of Biology), Dr. Javier Monzon (Assistant Professor of Biology), Dr. Donna Nofziger Plank (Associate Professor of Biology), and Dr. Thomas L. Vandergon (Professor of Biology). Specialties of the faculty are diverse enough to accommodate all of the curriculum offered within the department. Table 4 shows a breakdown of each faculty member's specialty, and Table 5 shows the courses taught by each member of the faculty. Curriculum vitae for all full-time members of the Biology faculty are attached.

Prior to hiring Dr. Monzon, Dr. Laurieanne Dent was a Visiting Professor of Biology for the past four years. This position was necessary to offset teaching load reductions for administrative positions held by Brewster, Honeycutt, and Kats. In addition, Krista Lucas teaches Principles of Biology (BIOL 106), a GE lab science course for non-majors. Ms. Lucas has a B.A. in biology from Occidental College and a M.A. in Science Teaching from the University of North Carolina, Chapel Hill.

Members of the biology faculty display a high level of scholarly activity. Between 2010 and 2015, members of the biology faculty published 61 peer-reviewed papers and gave 43 presentations.

Many of these publications and presentations involved undergraduates. In addition, the Biology Program received $2,490,017 in funding from individual private donations, extramural federal grants, and private foundations. Some of this funding provided scholarship and research support for undergraduates in the biology program. In addition, these funds supported the purchase of equipment used for teaching and research.

Curriculum Vitae available for all faculty.

FACULTY/STAFF
Are there sufficient numbers of faculty/staff to maintain program quality? Do program faculty/staff have the support they need to do their work?

Distribution of faculty across ranks - There are 35 tenured or tenure-track faculty members in the Natural Science Division. Currently, there are 27 tenured and 8 tenure-track professors. There are three major ranks, Assistant Professor, Associate Professor, and Full Professor. Within each rank there are three steps. Disregarding the steps, there are 1 University Professor, 20 Full Professors, 6 Associate Professors, and 8 Assistant Professors. The following is a breakdown by programs within the division.
The Biology Program has seven tenured members of the biology faculty and one tenure-track professor, Javier Monzon. The distribution of rank is as follows: 1) University Professor - Rodney Honeycutt; 2) Professor 4 - Stephen Davis; 3) Professor 3- Jay Brewster, Lee Kats, Karen Martin, Tom Vandergon; 4) Associate Professor 2 - Donna Nofziger Plank; 5) Assistant Professor 1 - Javier Monzon.
Number of full-time faculty & ratio of full-time to part-time - The Biology Program has 8 full-time faculty. Nevertheless, Professor Lee Kats serves a minimal teaching role in the program because he is Dean of Research and Vice Provost. University Professor Rodney Honeycutt is Divisional Dean of Natural Science and teaches a third of the time, and Professor Jay Brewster is Associate Provost and teaches approximately two thirds of a full teaching load.
For three semesters (Spring 2014, Fall 2015, Spring 2015), an adjunct professor is now teaching BIOL 106, one of the GE lab science courses in biology. Her appointment is necessary so at least one to two GE courses can be offered each semester.
Student/Faculty ratio - From the spring of 2011 to the fall of 2015, the average student/faculty ration for biology courses averages 23/1 (range of 15.9 to 28.6) for lectures and 12.3/1 (range of 9.3 to 14.2) for. As can be seen from the attached graph, the ratio shows an increase from the low values in 2011. This partially reflects several years of a larger incoming freshman class.
Faculty workload - The maximum number of units a tenured member of the faculty is expected teach in an academic year (9 months) is 24 units or 12 units per semester. The formula used to determine workload is as follows: 1) Three hours of lecture receives a credit of 3 units. 2) For each 3 hour lab, the faculty member receives 2.75 units of credit, and 1.75 units for a 2 hour lab. With the exception of BIOL 328 (Environmental Policy and Politics), all biology courses for majors have 3 hour labs. Biology courses taught as part of the GE lab science requirement are 2 hours. Full time pre-tenured faculty members are required to teach 20 units per year. This is designed to provide more time for both course development and establishment of his or her research program. Generally, a pre-tenured member of the faculty will teach 8 units one semester and 12 units in the other semester.
For the past 5 years and longer (see attached table), several of our tenured members of the faculty have teaching reductions as a result of administrative appointments and titled professorships. For several years, Professor Lee Kats has an appointment as Dean of Research and Provost. As a result, his expected teaching in the biology program is limited. In their respective roles as Associate Provost and Divisional Dean of Natural Science, Professor Jay

Brewster and University Professor Rodney Honeycutt collectively teach 24 units per year. This reduction amounts to one full-time tenured professor position. Finally, Professor Karen Martin and Professor Steve Davis each receive 4 units of teaching reduction as a result of their titled professorships.

Until the fall of 2015, teaching reductions of tenured faculty and increases in student enrollment were offset with the use of a fulltime Visiting Professor position. This position was replaced with a tenure-track line, and Assistant Professor Javier Monzon now occupies this position.

Faculty review and evaluation process - All fulltime and visiting faculty in the Natural Science Division are asked to complete an Annual Faculty Activity Form. This form asks each member of the faculty to outline his or her activities in the areas of scholarship, teaching, and service. The Divisional Dean of the Natural Science Division reviews each of these annual reports and assesses student teaching evaluations of courses taught by each member of the faculty. After evaluating each report, the Divisional Dean provides written feedback of the faculty member's teaching and achievement, and the faculty member is asked to provide any written comments related to the evaluation. In addition, the Divisional Dean has one on one conversations with any faculty member needing further follow-up to the evaluation.

For fulltime members of the faculty, each rank (e.g. Assistant, Associate, and Full Professor) has three steps. Based on information related to a faculty member's scholarship, teaching, and service, the Divisional Dean can recommend a step increase within a particular rank to the Dean of Seaver College, who makes the final decision regarding the step increase. Promotion to a higher rank, such as Assistant Professor to Associate Professor or Associate Professor to Full Professor, requires an evaluation by the Rank, Tenure, and Promotion (RTP) Committee, which consists of voting tenured representatives from each division in Seaver College as well as a non-tenured professor. For promotion in rank, the faculty member must provide information on Teaching Effectiveness, Scholarly Activity, and Service (professional, university, division, community). With the approval of the Divisional Dean, the candidate for promotion is asked to designate five peer reviewers, who will be asked to evaluate the information provided by the candidate. Each of these designated reviewers will provide a formally written response to each of the major categories, and the Divisional Dean will provide an independent response that includes details of the faculty member's teaching evaluations submitted by students. The RTP committee evaluates the evidence and makes a recommendation to the Dean of Seaver College, who has independently evaluated all of the evidence submitted on behalf of the candidate. The Dean's recommendation is then sent to the Provost and President.

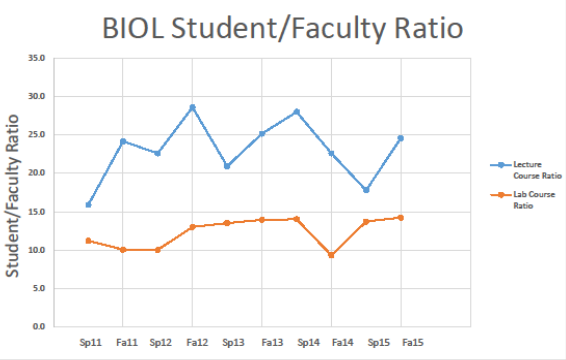
The above outlined procedure is basically the same used for an individual submitting for tenure and promotion. All members of the faculty considered tenure-track receive a pre-tenure review that uses the same criteria as those outlined for tenure and promotion. This review occurs mid-tenure and is designed to provide constructive feedback concerning teaching, scholarship, and service. It also allows for the college to determine whether or not the faculty member should continue. If the evaluation suggests no reappointment, the faculty member is allowed to stay the following year prior to termination. If the reappointment is approved, the Divisional Dean and faculty member will go over the RTP report and decide the best course of action to address any identified weaknesses.

After tenure, each member of the faculty receives a five-year evaluation. The basic procedures are similar to those outlined for tenure and promotion, except only three designated peer reviewers are required. The RTP committee makes a recommendation to the Dean of Seaver College, and the Dean decides the appropriate merit raised based on the outcome of the evaluation.

Mentoring processes - All pre-tenured members of the faculty are assigned a senior mentor by the Associate Dean. In addition, the Associate Dean schedules workshops related to navigating the tenure process. All tenured and tenure-track faculty are required to submit a detailed annual report that outlines their pedagogy, scholarship, and service. The Divisional Dean of Natural Science evaluates these reports and examines student evaluations taught by each member of the faculty. After this initial evaluation, the Divisional Dean writes a formal assessment and provides

information on student evaluations for the courses taught. The faculty member also is provided a written response from the Divisional Dean. After the faculty member receives this evaluation, the Divisional Dean and the faculty member meet to discuss any issues raised in the evaluation. The faculty member is provided an opportunity to provide a written response. Both the mid-tenure and five year reviews also provide each faculty member with input as to his or her progress. Professional development opportunities and resources (including travel and research funds) - All members of the faculty in the Natural Science Division receive support to attend scientific meetings. This support averages close to $2,000 per professor, and can be higher for international meetings. Research funding is available through the Dean of Research at Seaver College, and we have a grant writing facility available to faculty. Faculty can apply for a teaching reduction by writing a research or teaching proposal, and the success rate for such reductions is high. In addition, all members of the faculty are eligible for a one semester sabbatical. Equipment and laboratory maintenance is paid for by the Natural Science Division and the Seaver Dean. Sufficient time for research, program development - We attempt to organize teaching schedules so that members of the faculty do not teach every day of the week. This provides time for research. In addition, support is available for research assistants. No members of the faculty in the Natural Science Division are required to teach during the summer. Therefore, they have nearly four months for research and development.

d. Student/Faculty Ratio



e. Faculty Workload

Faculty Member	Tenured or Tenure-Track	Rank	Biology	Teaching Load
Jay Brewster	Yes	Professor III	Ph.D	16 Units Annually/Associate Provost
Steve Davis	Yes	Professor IV	Ph.D	20 Units Annually
Rodney Honeycutt	Yes	University Professor	Ph.D	8 Units Annually/Divisional Dean of NASC
Lee Kats	Yes	Professor III	Ph.D	None/Vice Provost
Karen Martin	Yes	Professor III	Ph.D	20 Units Annually
Javier Monzon	Yes	Assistant Professor II	Ph.D	20 Units Annually
Donna Nofziger Plank	Yes	Associate Professor II	Ph.D	24 Units Annually
Tom Vandergon	Yes	Professor III	Ph.D	24 Units Annually