A. ASSESSMENT OF INTERNAL AND EXTERNAL FACTORS AND STUDENT SUCCESS: Perform a SWOT analysis of your program, indicating the STRENGTHS, WEAKNESSES, OPPORTUNITIES, and THREATS in relation to program goals and available resources, including an evaluation of the curriculum in terms of student needs. Analyze the external factors affecting program goals and performance, e.g., changes in demographic, educational, social, economic, workforce, or global trends; evolving technology; demand (based on enrollment trends or other factors); linkage with other related campus programs, services, or committees; local availability of similar programs; availability of auxiliary funding. Include supplemental survey results and other data whenever available. (References: Educational Master Plan; Curriculum Sheet; Department and All-College Program Review Data (Retention, Success); 1999-2000 Program Planning Summary; Other)

The Biology department's greatest asset is the enthusiasm and dedication of the faculty, staff, and administrators involved in our program. We have a very cohesive department that works in concert as a team. We meet weekly to tackle various issues and projects needed to successfully manage the department. Another strength is our laboratory facilities. Thanks to our connections with the biotechnology program, our cell and molecular biology labs are among the most sophisticated of any educational institution in the country. Access to computer and multimedia technology across the campus is another strength.

With respect to weaknesses, our greatest challenge is scheduling difficulties that result from limited lab and lecture facilities. This is especially true for lab space, which will ultimately determine our growth in the next few years. Other weaknesses include reliance on part-time faculty (human and marine biology are now taught exclusively by part-time faculty), the pace at which we can alter and update our curriculum, and the lack of advanced computer technology within lab rooms used for physiology and ecology.

Our greatest concern, which is both a weakness and an opportunity, deals with student success and diversity equity. While our success rates are within the same range as other science disciplines, we would like to see improvements. Both recruitment and success of underrepresented groups also need to be addressed and improved.

Several opportunities for the Biology program lie in our immediate future. The most obvious of these is the new science building. The building will not address all of our space issues, but it will certainly help and may eliminate some of the space issues entirely. In particular lecture space and both computer and multimedia access should improve immediately when the building becomes available.

Next year for the first time in many years, the biology department will be fully staffed with 6.2 full-time faculty (20% of Celeste Carter's load is in the biology department). The richness of ideas for growth in the department is a direct result of these new employees whose presence brings fresh ideas and whose contributions create more time for the entire department to set and achieve new goals. In the sections that follow are proposals to increase course offerings within the Biology department. These increases include new sections for existing courses and new courses we hope to develop in the coming years.

There are two things that threaten the growth and success of this department. Budget cuts and limited lab and lecture space. These two factors directly result in a teacher to student ratio that hinders student success and creates a ceiling on how many courses we can offer. Current growth rates and projections for population increases suggest that demand for biology course will continue to increase, but instead growing we already turn students away because we do not have the materials, faculty, staff, or space to increase our course offerings.

1. Internal factors:
   Class size in our program is generally too big, and lab size especially is too big. Lab sections should not exceed 25 students, and ideally should be limited to 20 students. Currently most labs have 30 to 32 students. Our small lecture sections typically have 60 to 72 students and some lecture sections (general biology, anatomy and physiology) have 120 to 180 students.
   We need more rooms to accommodate the large lecture sections. Further all the lecture rooms need to have full multimedia equipment as well as low tech methods of delivery (improved overhead projection of transparencies and large white boards). Advances have been made in this area since the last program review, but more is needed especially in the 5500 lecture
rooms. We also have an increasing need for additional lab space. Currently we can still fit our curriculum into five lab rooms. If projected growth is accurate, we will likely have need for at least one more lab room in the future. To maximize current lab space we need to increase use of lab rooms during the morning hours. Since lab sections meet for three hours, blocked scheduling in other divisions across the campus is needed. (With block scheduling across campus, taking a morning lab does not have to preclude taking three other courses.)

Our program is no longer understaffed, but if projected growth continues this will change. Finding and keeping good part time instructors continues to be a struggle, consuming much time and causing anxiety for our division dean and program director. We need to develop a part time pool with multiple areas of expertise especially in the fields of marine biology, human biology, general biology, anatomy and physiology. Historically many of our excellent part time instructors have secured full time positions, thus becoming unavailable to teach at Foothill. There continues to be a need to develop procedures to integrate and orient evening part time faculty more effectively to the life of the program, division and college.

Our curriculum is excellent as it stands, but it needs to be easier to develop, introduce and build new courses, as well as improve old courses. This process may take a year or more to accomplish and sometimes involves temporarily accepting relatively low enrollments until a new or renovated class “catches on” or “takes off.” This implementation is too slow and we need to find ways to expedite the process. We continue to systematically review all of our courses and have several new courses we would like to develop.

2. External factors:

We need to continue to collaborate with the biology department at De Anza to bring courses at our two institutions into harmony and correspondence. Improvements have been made in both the major sequence (1A, 1B and 1C) and the anatomy and physiology sequence (40A, 40B and 40C). Currently our biggest difference is in the microbiology course – De Anza’s course requires four hours of lecture per week, while Foothill's course requires only three hours per week. We are in the process of evaluating our course and other local offerings of microbiology to determine if we should adopt De Anza’s unit load. Our preliminary findings suggest that we should increase the unit load for microbiology by one unit.

Currently biology has a 13% increase in enrollment over last year. This quarter the microbiology course (41) turned away 26 students (slightly more than one full lab section). The evening anatomy and physiology course (40A) usually has two lab sections with 30 students each. This quarter we added another lab section and then turned away another 90 students (three full lab sections). Both of these courses are primarily program support and prerequisite courses suggesting an increasing demand for training in the allied health field. This is consistent with historical trends for retraining in allied health during periods of economic downturn. In February the San Jose Mercury News projected that the Silicon Valley would show no economic recovery until 2011. This suggests that the demand for program support courses will continue for several more years. Add this to an expanding adult population as children of “baby boomers” come of age, and we anticipate a continued increasing demand in all our courses. (The proposed changes to deal with this increase are presented in section D.2 below.) Available lab space, materials and support staff are limiting factors in our ability to meet these enrollment increases.

We need to continue to develop better ways of serving the increasing numbers of ESL students who are enrolling in our classes, without compromising the quality of instruction we offer native speakers of English. We also need to address the recruitment, retention and success of underrepresented groups in the biological sciences.

B. STUDENT SUCCESS EVALUATION: Briefly discuss how the program is performing relative to program and college projections for student success. Comment on specific student success programs or services provided by the college that you perceive to be particularly valuable to your students. Identify unmet needs related to student success. (References: Educational Master Plan; Curriculum Sheet; Department and All-College Program Review Data (Success); 1999-2000 Program Planning Summary; Other__)

Biology program student success was measured at 73% for the 2001-02 year. This is lower than the success for the Biological and Health Sciences Division (94%), and lower than the success for the college (84%). To address the question of whether or not these lower numbers are a reflection of the difficulty non-majors have with science, we looked at other science divisions. Our student success is within the range seen in other science divisions (Physical Sciences and Engineering Division, 70%; Computer Information Systems Division, 75%). Looking at the three-year history for student success,
student success in our program has been decreasing; other science divisions have success rates that are increasing.

One explanation for the difference in success between our department and the rest of the division deals with the nature of students enrolled in courses. The rest of the division consists of students enrolled in certificate programs. These students are typically highly motivated, focused and determined to successfully complete their program. Most of the students in the biology department are enrolled in general education courses. While most of these students are also highly motivated, focused and determined to succeed, there are also many students that are still deciding what they want to do. These students are much younger and at often at a crossroads. Many students begin their biology general education class in one quarter, discover how to study, drop and then return the next quarter to succeed. In short, the general education students are often learning much more than biology and that maturing process requires more time and effort. (For example, each quarter about two to five students in biology 10 are referred to disabled student services. Those students who follow through with disabled student services are usually diagnosed with learning disabilities and after receiving the help the need, return to the course and pass with a grade of A or B.)

It would be helpful to do a correlation analysis to explore the relationship between class size and student success; over the same three-year period our class sizes have increased. If a positive correlation exists, we should limit student enrollments accordingly. If budget realities prevent this we should at least examine load policies for large classes. In particular, rather than doubling lecture load at 100 students, it might make more sense to increase lecture load to 150% at 90 students and 200% at 120 students (increments based on typical lab section size). These load changes increase instructor availability outside the classroom allowing time for extra office hours and review sessions.

Regardless of the cause, our faculty would like to reverse the current trend. A mentoring program patterned after Pass the Torch may be one avenue to explore. More specifically we would like to offer independent study units for students who have completed a biology course with an A and would be willing to mentor and tutor students during subsequent quarters. Ultimately we should develop a course (Introduction to teaching biology) that trains students for teaching and creates an opportunity to answer both subject matter and pedagogical questions for our mentors. By adding a laboratory component to the course we could create a program similar to the math lab allowing students to drop in for help with any biological subject. Another approach involves using students as assistant instructors in the lab courses. Student assistants provide an additional person beside the instructor for students to turn to for help with procedures or questions (focusing a microscope, confirming the identification of a cellular or anatomical structure, etc.) A similar program at UC Berkeley has been very successful. (Please note that the Premed club has recently discussed developing tutorial and support groups for all science courses.)

C. STUDENT EQUITY/DIVERSITY ANALYSIS: Student equity may already be defined as a factor in the above assessments. Use this section to offer additional observations and to specify other needs related to bringing your program into alignment with college or program goals for student equity. (References: Educational Master Plan; Division and All-College Program Review Data (Success by Ethnicity, Gender, Age); Other __________________________)

Currently, Asian (78%), Native American (100%) and White (77%) students in the Biology program succeed at a rate higher than the program average (73%). Black (58%), Filipino (57%), Hispanic (58%) and Pacific Islander (70%) students have a lower success rate than the program average (73%). It is difficult to tell how much these differences are a reflection of low entry numbers. For example, only 5 Native American students were in our program last year. Interestingly, three of the lowest performing group of students make up less than 4% of the enrollment in Biology (Black students make up 2.4% of the biology student body, Filipino students 3% and Pacific Islander students 1.8%) Hispanic students make up only 10% of the enrollment in Biology. This suggests that part of the problem may lie in recruitment of these underrepresented groups.

The department’s greatest influence on recruitment lies in the general education courses. Faculty estimate a 1 to 2% recruitment into the major in each of those classes. Anecdotal data suggests that the course that typically has the greatest student diversity is human biology. We should confirm this with the instructional research officer on campus. If correct, one approach to addressing recruitment of underrepresented groups would be to expand human biology. By increasing the number of entering students we would also increase the number of potential mentors and role models for these groups of students. The Pass the Torch and Puente program success certainly suggests that this approach would be helpful.
D. ACTION PLANS AND PROPOSED PROGRAMMATIC CHANGES: Review the Education Master Plan (EMP), Partnership for Excellence (PFE) goals, Curriculum Sheet, and Department Program Review Data. Using measurable terms, describe the program's goals related to these documents. (Examples: “The number of students issued a Career Certificate will increase by five over last year's figure.” “The program will initiate an advisory board.” “Faculty will examine learning goals for their programs and courses.” Etc.)

1. Program Goals Related to Educational Master Plan and Partnership for Excellence:
   Our department needs to increase recruitment of underrepresented groups into the field of Biology. We also need to improve student success and retention for all students and especially for underrepresented groups. Faculty will develop new programs (mentors, tutors, student assistant lab instructors) and new courses (adjunct courses) to facilitate improvements in student success and retention. Our goal is to increase enrollment by 400 students each year with a 2 to 3% increase in student success for all groups each year for the next three years. Beginning in the year 2005 we want to achieve a 3% increase in enrollment for each underrepresented group each year. Realistically budget concerns will limit our growth and our ability to start new programs.

2. Other Program Improvement Plans:
   Curriculum changes for majors:
   Currently a major sequence (BIOL 1A, 1B, 1C) begins in the fall and winter quarters each year. For each course in the sequence there is one quarter each year when the course is not taught. We propose that each course should be offered every quarter. Thus we should begin a third sequence each spring. For each quarter this would mean an additional four-hour lecture and four labs increasing the department FTEF by .8691 per year.
   To protect our investment in expensive lab equipment, the department needs to offer a course in laboratory skills to ensure proper handling of lab equipment, in particular microscopes, spectrophotometers, pipetmen and electrophoresis gel boxes. This would be a short course offered in the summer and the beginning of each quarter. This course would be a prerequisite for taking any major's biology lab course or microbiology.
   Four hours of lecture is not sufficient to cover the material in Introduction to Molecular Genetics (BIOL 1D) at the depth required for this course. Biology 1D was added to the curriculum to address the concerns of some of our transfer schools, especially San Jose State University. The course is designed to introduce students to both topics in molecular genetics and to prepare students for the increased rigor required for upper division work. Students currently enrolled in 1D are requesting a second course in molecular genetics; this is not reasonable. A good compromise would be to increase the units for 1D to five hours of lecture per week. Increase to department FTEF would be .0222 per year.
   Perhaps the most rapidly growing area within our field is developmental biology. Especially with the completion of genome sequences and the resulting opportunity to compare entire genomes, developmental biology for the first time in over 150 years is achieving significant advances in our understanding. As such we feel students need a stronger introduction to this topic. We propose the addition of an optional, five-unit lecture only course to the major's curriculum, biology 1E - Introduction to Developmental Biology. Increase to department FTEF would be .1111 per year.

   Curriculum changes to program support courses:
   Currently the Anatomy and Physiology sequence (BIOL 40A, 40B and 40C) begins in fall quarter only during the daytime and begins in the fall and winter at night. To meet the increasing demand for this course we propose to begin a second sequence during the day each winter. The fall sequence would be limited to five lab sections (150 students in lecture) with three afternoon labs and two morning labs. Note that currently we have six labs in the fall. The winter sequence would be limited to four lab sections (120 students in lecture) with two morning labs and two afternoon labs. Increase to department FTEF would be .8848 per year.
   Currently Microbiology (BIOL 41) offers two lab sections each quarter. Next year we are offering two lab sections in the fall and winter quarters, and three lab sections in the spring. We propose offering three lab sections each quarter (increase to department FTEF for this change is .2008 per year). Additionally there is a need for an autonomous evening lecture and lab section for the winter and spring. Increase to department FTEF would be .3342 per year. Both changes are not possible with current lab facilities.
   Currently Introduction to Nutrition (BIOL 45), a required course for the Dental Hygiene program, is only offered at DeAnza. We propose adding the course back into the biology
curriculum at Foothill. Furthermore Biology 45 should be offered as a hybrid course allowing some students to complete this course online. Increase to department FTEF would be .0889 per year.

The Bioinformatics program is being impacted by the unavailability of Human Genetics (BIOL 12) during the winter and spring quarters. We also receive requests from non-program students each winter and spring to offer human genetics more frequently. Beginning next year human genetics will be offered every quarter. Increase to department FTEF is .1778 per year.

Curriculum changes to general education courses:

Human Biology (BIOL 14) is the only biology course that fulfills the multicultural requirement needed to graduate from Foothill. This also is the general education course that seems to have the highest minority enrollment. For both reasons we want to build this course, offering an additional lab section each quarter. Simultaneously we need to limit the lab sections for General Biology (BIOL 10) to five or six lab sections per quarter. Increase to department FTEF would be .1506 per year.

To help improve student success, we need to develop adjunct courses for some of our general education classes, beginning with General Biology and Human Biology. These courses would be one-unit discussion classes in how to study biology. The General Biology adjunct course would meet on Fridays at 10:00 (the same hour the largest section meets Monday through Thursday). The Human Biology adjunct course would meet Tuesday at 1:30. Increase to department FTEF would be .1332 per year.

We need to continue to increase our offering of lecture only courses and several of these courses should be hybrid courses allowing students to satisfy their life science requirement online. In addition to the previously mentioned increase in offering human genetics, we propose the development of two new courses: Biology of Cancer and Ethical Issues in Genetics. Biology of Cancer is needed just for the community service aspect of Foothill's mission. Ultimately similar courses addressing infectious diseases (HIV, hepatitis, meningitis, etc) and cardiovascular disease should also be offered. These courses should be offered as evening classes with local adult (especially parents) students as our primary target audience. Increase to department FTEF for the biology of cancer course would be .0889 per year. Additional development is needed to determine how best to structure courses on other disease topics. One possibility would be to create a collection of short courses that address one specific disease. Ethical Issues in Genetics would meet two needs, community service and continued education requirements for genetic counselors. San Jose has one of the largest cytogenetics labs in the country and a large group of genetic counselors operate in conjunction with this lab. There currently is no community college meeting their need for continued education. This course should be taught at night and should be offered as a hybrid course online. Increase to department FTEF would be .0889 per year.

Nature Photography is another new course under development. This course would be part of a learning community with students receiving two units for biology and two units for photography. The course format proposed is one hour of biology lecture introducing the flora and fauna of a particular field site and a three-hour lab to visit and photograph the field site. Increase to department FTEF would be .0724 per year.

We should also try to reactivate some courses that would support the GIS certificate program. In particular Ecology and Natural History (BIOL 15), Ornithology (BIOL 16) and Environmental Science (BIOL 20) could all be written to function as field courses that support the GIS certificate program while giving students practical experience. Each course could be taught once a year on rotating quarters. Increase to department FTEF for all three courses would be .5679 per year.

E. ENROLLMENT AND PRODUCTIVITY GOALS (References: Program Review Data Sheet (Enrollment and Productivity); Other _____________________)

Our department goal is to maintain productivity between 650 and 700. Our goal is to increase enrollment by 400 students each year for the next three years. Beginning in the year 2005 we want to achieve a 3% increase in enrollment for each underrepresented group each year. Realistically, budget and space issues will limit our opportunity for growth.

F. SUMMARY OF RESOURCES REQUESTED: Summarize resources needed to reach program goals and describe the expected outcomes for program improvement. (Specifically what will be the outcome of receiving these resources? What will happen if the resource requests aren't granted?) Complete any of the following sections that apply to your current program needs.
1. FULL-TIME EQUIVALENT FACULTY OR STAFF NEEDS

If all the program changes outline above occurred, we would increase the Biology Program FTEF by 3.7908 per year. To maintain our current percentage of full-time instructors we would need to hire three new full-time faculty. Currently the Biology Program director gets 10% reassign time. This is the largest program in the division and receives the least amount of reassign time. Frankly, the job cannot be done properly with this amount of time. The director position should be 15% and there should be an additional 5% for doing the schedule. Anything less is unrealistic.

Ten years ago there were only 71 labs per year and one full time lab technician to prepare these labs. Currently the Biology Program has one full time lab technician to prepare 101 labs; next year there will be 105 labs. Further more, the labs have become more sophisticated and more complicated over the last decade. This is too much work for one person. To meet our current needs we need a permanent 50% position for a laboratory assistant. If we add the proposed 37 new labs, we need a total of least two full time lab technicians and preferably an additional 50% position.

Instructors (both full and part time) need more training time to make full use of multimedia and computer technology.

2. FACILITIES NEEDS

If all the program changes outline above occurred, we would be teaching an additional 37 new labs (not including the laboratory skills short courses). By increasing use of the lab rooms during the morning, midday, and evening hours we can accommodate most of the changes. But some changes will require additional lab space. The most likely configuration for lab space if all additions are made would be as follows: Lab 1 & 2, shared by 1A, 41 and the biotech courses; Lab 3 shared by 1B, 14 and 40; Lab 4 shared by 1C, 13, 15, 16 and 20; Lab 5 used exclusively by 40; Lab 6 used exclusively by 10. We only have five lab rooms - we need one more room. Growth, especially for major's courses and program support courses will be limited if we do not have a sixth lab.

3. MATERIALS AND SUPPLIES BUDGET AUGMENTATION:

Our B budget has not increased as rapidly as our enrollment and productivity have. This current budget is barely adequate to cover our current needs and the 10% decrease projected for next year will create a significant challenge to maintain the quality of instruction. We need to increase the use of computer technology in the labs, especially for physiology experiments, modeling ecological experiments and completing bioinformatic analyses. The latter two items can be completed in any computer lab that has the appropriate software. The physiology experiments require both recording hardware and analytical software. We currently cannot afford this equipment, which means we continue to teach primarily anatomy and not physiology in biology 1B, 14 and 40.

If we add all the courses suggested above, we will need to purchase some duplicate models and slides especially for the anatomy and physiology related courses (BIOL 1B, 14 and 40).

Currently, the autoclave is the only equipment that has a maintenance budget. This needs to change. All of the following require routine maintenance to ensure longevity and proper functioning: microscopes, refrigerators, spectrophotometers, balances, pipetmen, centrifuges and electrophoresis equipment. For example, when our microscopes were serviced three years ago, the biology 1B class saw some plant structures clearly for the first time in seven years. It profound difference to keep the equipment properly maintained. It also saves money in the long run since were taking care of equipment rather than replacing equipment. Our best estimate is $10,000 to $15,000 dollar budget for maintenance.

The Biotechnology Program should have its own budget, rather than the current situation.

Evaluation of academic year 2001-02. 

List names of participants assisting in this program review.
Primary program contact person: Kathleen Duncan
Phone or email address: 7404
Full-time faculty: Kathleen Duncan, Karen Erickson, Carolyn Holcroft, Martin Melia and Lisa Schultheis.
Part-time faculty: Laura Brauman
Administrators: Mary Ann Pavic
Classified staff: Marcia Bhide
Students:
Program Name: BIOLOGY  
Degree/certificate options available: A.S. Degree in Biology

**PROGRAM MISSION AND OUTCOMES:**
The biology department has three primary missions: successful transfer of biology majors to four year institutes, provide a variety of courses to satisfy general education requirements, and provide educational support for Foothill's allied health programs.

1. The goals of the transfer program are to prepare students for careers in many fields of biology, including health professions, teaching, forestry, agriculture, environmental protection and conservation, wildlife biology, biotechnology, and basic research; and to prepare students for transfer to a four year university to pursue a B.S. degree. Graduates of this program will describe the fundamental concepts of cell biology, molecular biology, organismal biology, evolution, ecology, and systematics; demonstrate knowledge of chemical and/or physical concepts relevant to biology; and apply the scientific method to study problems.

2. The goals for general education are to provide students with a working knowledge of the scientific method, empower individuals to critically evaluate scientific information, empower individuals to become personally involved in their own and/or the planet’s well being, prepare students to make informed decisions in the jury box and voting booth.

3. The goals for program support are to provide students with a fundamental understanding of in the basic concepts in anatomy and physiology, microbiology, nutrition, pharmacology, general biology and/or human biology.

| DIRECT OUTCOMES: Program-Specific Outcomes and Attributes Desired of Program Graduates |
|-----------------------------------------------|-----------------|--------------------------|
| PROGRAM CONTENT PROFICIENCIES/COMPETENCIES | BEHAVIORS: What should a student be able to do upon graduation? | REQUIRED PROGRAM COURSES related to this outcome: Where do students acquire experience? | OUTCOME MEASURES — Evidence or Sample Demonstrating Deep Learning: How do we know what a student has achieved? |
| Knowledge of biological concepts – Cell and Molecular Biology | Demonstrate understanding of biological macromolecules, structure and function of eukaryotic and prokaryotic cells, bioenergetics, genetics, expression of DNA, and cell communication | BIOL1A | DIRECT MEASURES  
Students will receive a “C” or better in all courses listed. |
| Knowledge of biological concepts – Organismal Biology | Demonstrate understanding of the structure and physiological processes of plants and animals (including transport systems, reproduction, nutrition, gas exchange, regulation of the internal environment, response to external stimuli, defense against disease, nervous systems, hormones, and locomotion) | BIOL1B | DIRECT MEASURES  
Students will receive a “C” or better in all courses listed. |
| Knowledge of biological concepts – Evolution, Ecology, Systematics | Demonstrate understanding of the principles of evolutionary theory, classification and evolutionary history of bacteria, protists, plants, animals, fungi, and basic ecology | BIOL1C | DIRECT MEASURES  
Students will receive a “C” or better in all courses listed. |
| Knowledge of chemical and/or physical concepts relevant to biology | Relate chemical and/or physical principles to biological systems | BIOL1A, 1B, 1C; CHEM1A, 1B, 1C and CHEM12A, 12B, 12C or PHYS2A, 2B, 2C or PHYS4A, 4B, 4C | DIRECT MEASURES  
Students will receive a “C” or better in all courses listed. |
| Scientific Method | Propose/design experiments to address a question; critically analyze experimental data to draw conclusions; critique experimental design/outcomes | BIOL1A, 1B, 1C | DIRECT MEASURES. Students will:  
1. Receive a “C” or better in all courses listed  
2. Design an independent research project, do oral presentations, and write a report. |
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<th>PROGRAM CONTENT PROFICIENCIES/COMPETENCIES</th>
<th>BEHAVIORS: What should a student be able to do upon graduation?</th>
<th>REQUIRED PROGRAM COURSES related to this outcome: Where do students acquire experience?</th>
<th>OUTCOME MEASURES — Evidence or Sample Demonstrating Deep Learning: How do we know what a student has achieved?</th>
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<td>Application of biological principles to evaluate scientific data and make practical decisions</td>
<td>Demonstrate understanding of the dynamics of the living world; apply knowledge of biological principles to preventive and palliative medicine; apply knowledge of genetic concepts to evaluate ethical issues and choices in genetics; apply knowledge of ecology to improve local and global environmental conditions</td>
<td>BIOL 10, 11, 12, 13, 14, 17</td>
<td>DIRECT MEASURES Students will receive a “C” or better in all courses listed.</td>
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<td>Understanding of fundamental biological principles required for allied health professionals</td>
<td>Demonstrate fundamental understanding of basic concepts in anatomy and physiology, microbiology, nutrition, pharmacology, general biology and/or human biology</td>
<td>BIOL 40A, 40B, 40C, 41, 45, 46, 10, 14</td>
<td>DIRECT MEASURES Students will receive a “C” or better in all courses listed.</td>
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**CORE COMPETENCIES**

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<th>CORE COMPETENCIES: Outcomes and Attributes Distinct to This Program</th>
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| **Communication** | 1. Demonstrate effective oral and written communication of experimental results  
2. Write abstracts describing biological research  
3. Prepare written critiques and summaries of current biological research |
| Biologically related courses | BIOL1A, 1B, 1C, 1D; CHEM1A, 1B, 1C and CHEM12A, 12B, 12C or PHYS2A, 2B, 2C or PHYS4A, 4B, 4C |
| DIRECT MEASURES. Students will: | 1. Receive a “C” or better in all courses listed  
2. Receive a “C” or better for completion of an independent research project.  
Including an oral presentation and written a report describing the experimental design, data analysis and conclusions |
| **Computation** | 1. Collect and analyze data  
2. Use graphic techniques to discuss and interpret experimental results  
3. Apply elementary statistical tools (t, F, and Chi square tests) |
| Biologically related courses | BIOL1A, 1B, 1C, 1D; CHEM1A, 1B, 1C and CHEM12A, 12B, 12C or PHYS2A, 2B, 2C or PHYS4A, 4B, 4C |
| DIRECT MEASURES. Students will: | 1. Receive a “C” or better in all courses listed  
2. Receive a “C” or better in the laboratory section of all courses listed  
3. Receive a “C” or better for completion of an independent research project.  
Including an oral presentation and written a report describing the experimental design, data analysis and conclusions |
| **Creative, Critical & Analytical Thinking** | 1. Design scientific experiments  
2. Evaluate and draw conclusions from experimental data  
3. Prepare peer critique of research projects  
4. Demonstrate an ability to work independently to solve a problem  
5. Demonstrate an ability to complete literature reviews and critical analysis of current biological research |
| Biologically related courses | BIOL1A, 1B, 1C, 1D; BIOL 33A, 33B, 33C, 33D; CHEM1A, 1B, 1C and CHEM12A, 12B, 12C or PHYS2A, 2B, 2C or PHYS4A, 4B, 4C |
| DIRECT MEASURES. Students will: | 1. Receive a “C” or better in all courses listed  
2. Receive a “C” or better in the laboratory section of all courses listed  
3. Receive a “C” or better for completion of an independent research project.  
Including an oral presentation and written a report describing the experimental design, data analysis and conclusions |
| **Community/Global Consciousness & Responsibility** | 1. Demonstrate an ability to work in groups to complete laboratory experiments and presentations  
2. Apply basic ecological concepts to understand and suggest solutions for local and global health and environmental concerns |
| Biologically related courses | BIOL1A, 1B, 1C; CHEM1A, 1B, 1C and CHEM12A, 12B, 12C or PHYS2A, 2B, 2C or PHYS4A, 4B, 4C |
| DIRECT MEASURES. Students will: | 1. Receive a “C” or better in all courses listed  
2. Receive a “C” or better in the laboratory section of all courses listed  
3. Receive a “C” or better for completion of an independent research project.  
Including an oral presentation and written a report describing the experimental design, data analysis and conclusions |