

**MARYLAND HIGHER EDUCATION COMMISSION  
ACADEMIC PROGRAM PROPOSAL**

**PROPOSAL FOR:**

- NEW INSTRUCTIONAL PROGRAM**  
 **SUBSTANTIAL EXPANSION/MAJOR MODIFICATION**  
 **COOPERATIVE DEGREE PROGRAM**  
 **WITHIN EXISTING RESOURCES** or  **REQUIRING NEW RESOURCES**

*(For each proposed program, attach a separate cover page. For example, two cover pages would accompany a proposal for a degree program and a certificate program.)*

Carroll Community College  
Institution Submitting Proposal

Spring 2017  
Projected Implementation Date

Associate of Science  
Award to be Offered

Biology  
Title of Proposed Program

040100  
Suggested HEGIS Code

260101  
Suggested CIP Code

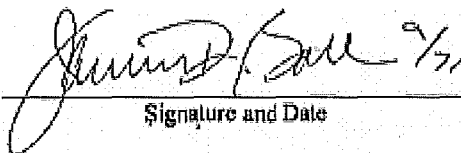
Sciences  
Department of Proposed Program

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Signature and Date

President/Chief Executive Approval

Date Endorsed/Approved by Governing Board

Date

**Sciences – AS in Biology**

**A. Centrality to institutional mission statement and planning priorities:**

**1. Provide a description of the program, including each area of concentration (if applicable), and how it relates to institutions approved mission.**

Carroll Community College's mission is to be a "public, open admissions, associate-degree-granting college serving Carroll County, MD with baccalaureate preparation programs, career education, workforce and business development, and personal and cultural enrichment opportunities. As a vibrant, learner-centered community, the college engages students as active learners, prepares them for an increasingly diverse and changing world, and encourages their lifelong learning." This mission is conveyed through ten college goals, three of which are expressly addressed by an Associate of Science (AS) degree program in biology:

*Goal 2: Provide opportunities for all learners to develop competencies in communications skills, critical thinking, quantitative and scientific reasoning, information and technological literacy, creativity, global awareness, and personal development.*

*Goal 3: Prepare students for completion of the baccalaureate degree through rigorous transfer programs, appropriate advising and support services, and effective articulation agreements.*

*Goal 4: Provide career preparation, job skill enhancement, continuing professional education, and career development services through credit and noncredit programs.*

The proposed AS degree program in biology seeks to meet the college's above goals of providing convenient and affordable baccalaureate preparation; encouraging students to be full and active partners in their learning; creating an environment supporting student and organizational learning; and assessing learning outcomes for the improvement of learning and instruction.

Through engaging lab, field, and classroom activities, the Science Division at Carroll Community College seeks to provide students with the current scientific knowledge and skills necessary to prepare them for their educational and career goals. The major goal of all courses in the biological and physical sciences is to involve the student actively in the use and understanding of the scientific method, using a variety of instructional modes, including technology, analysis and interpretation of data, oral and written communication, information literacy, problem solving, and critical thinking skills.

The AS degree in biology would then prepare students for further study or entry level positions. In addition to the regional and national need for well-prepared biology professionals in a wide range of professional settings, this program offers a stronger degree choice for students entering

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into college already certain of their career path. Opportunities in biology are growing regionally and represent a state-wide initiative to grow the life science career options and keep highly talented professionals within the state. This is a great program for Carroll Community College as it will allow students to meet personal career academic goals, as well as contribute to a strong talent pool for state-level commerce needs.

**2. Explain how the proposed program supports the institutions strategic goals and provide evidence that affirms it is an institutional priority.**

An AS degree in biology directly supports three initiatives of Carroll's current Strategic Plan:

*I-1 Program Completion: Analyze correlates of success and adopt best practices to support student degree, program, and credential completion.*

The AS degree in biology gives serious science students the encouragement to complete their two year degree rather than transferring to a four-year institution after only a semester or two of study. Though an Associate of Arts degree would also prepare science students for baccalaureate transfer, many of the more focused science students' perceptions of the worth of an AS degree over an AA degree becomes a strong motivator for degree completion. Since they place lower value on an AA degree, they frequently transfer part way through their program of study rather than completing the AA degree.

*I-2 Areas of Study, Pathways, and Student Academic Planning: Implement the Areas of Study, Academic Pathways, and Student Planning initiative to promote recruitment and retention.*

There currently exists no dedicated science program at Carroll. This hinders both advising and recruitment efforts. An AS biology degree program would allow for more streamlined and accurate student advising. It would also allow for marketing initiatives that would attract area high school STEM students who otherwise would enroll directly in four-year institutions, offering a biology program.

*II-1 Five-year Academic and CET Instructional Programming Plan: Identify current programs for enhanced development, and new instructional programs to launch over the next five years.*

As mentioned above, there are no science degree programs at Carroll. Development of an AS degree program in biology is in direct accordance with this initiative.

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**B. Adequacy of curriculum design and delivery to related learning outcomes consistent with Regulation.10 of this chapter:**

- 1. Provide a list of courses with title, semester credit hours and course descriptions along with a description of program requirements.**

*Figure 1: Table showing the proposed program of study for the AS in Biology degree (descriptions following)*

Semester 1			
Dept.	Course	Title	Credit
BIOL	101	Fundamentals of Biology 1 (General Education)	4
MATH	135	Calculus of a Single Variable 1 (General Education)	4
ENGL	101	College Writing (General Education)	3
CHEM	105	Principles of General Chemistry I (General Education)	4
<b>Semester Total</b>			<b>15</b>
Semester 2			
BIOL	102	Fundamentals of Biology 2	4
CHEM	106	Principles of General Chemistry 2	4
ENGL	102	Writing about literature (General Education)	3
ELECTIVE			4
<b>Semester Total</b>			<b>15</b>
Semester 3			
BIOL	240	Genetics	4
CHEM	201	Organic Chemistry 1	5
		Arts & Humanities Choice (General Education)	3
		Social & Behavioral Sciences Choice (General Education)	3
<b>Semester Total</b>			<b>15</b>

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Semester 4			
BIOL	215	Microbiology	4
CHEM	202	Organic Chemistry 2	5
		Arts & Humanities Choice (General Education)	3
		Social & Behavioral Sciences Choice (General Education)	3
		<b>Semester Total</b>	<b>15</b>
		<b>Total Credits</b>	<b>60</b>

**Course descriptions for proposed AS degree in Biology**

**BIOL-101**, Fundamentals of Biology 1, gives the student who is a science major the basic biological principles common to all living things. Biochemistry, genetics, and evolution serve as central themes for the topics, which include cell structure and function, molecular and cellular energetics, and genetics. Through experiments the student will gain familiarity with various biological techniques and principles. The course includes formulating questions and hypotheses, designing experiments and the collection, reporting, and interpretation of data. Prerequisite: exemption/completion of READ A-F and MAT-097 with a C grade or better. Credit by exam available. Three hours lecture, three hours laboratory each week. GENERAL EDUCATION

**BIOL-102**, Fundamentals of Biology 2, focuses on the principles of organismal, ecological, and evolutionary biology with emphasis on the phylogenetic and evolutionary patterns of major groups of organisms; the dynamics of populations, communities and ecosystems; and the principles of natural selection, population genetics and speciation. Emphasis is on formulating questions and hypotheses, designing experiments, and the collection, reporting, and interpretation of data. Prerequisite: BIOL-101 with a C grade or better. Three hours lecture, three hours laboratory each week. GENERAL EDUCATION

**BIOL-215**, Microbiology, is an introduction to the study of bacteria, viruses, fungi, and protozoa and their interrelationships with humans. General microbiological principles such as microbial structure, growth, metabolism, and genetics are applied to medically related topics such as the pathogenicity and control of microorganisms as well as body defense mechanisms and the immune response. The lab stresses the importance of basic microbiology lab techniques and clinical applications including slide preparation and microscopy, aseptic technique, and biochemical and serological testing for microorganisms. Both lecture and lab relate current microbiological principles to a better understanding of the infectious disease process. Prerequisite: BIOL-101 or an equivalent college biology course with a C grade or better within the last 5 years. Credit by exam available. Three hours lecture, three hours laboratory each week.

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**BIOL-240**, Genetics, gives the student who is a science major the basic principles in the field of genetics. Topics will include the history of genetics, major concepts of cell and molecular genetics, experimental approaches used to study genetics, and current topics in the field. Attention will be given to current techniques in biotechnology. Prerequisite: BIOL-101 with a C grade or better. Three hours lecture, three hours laboratory each week.

**CHEM-105**, General Chemistry 1, is the first semester course for students who intend to major in chemistry, life sciences and other areas that require a minimum of one semester and/or one year of college chemistry. Topics covered in the course include study of matter and measurements, atoms, molecules and ions, stoichiometry involving chemical reactions, solution stoichiometry, thermochemistry, the electronic structure of the atom, periodic properties, chemical bonding, molecular geometry, and the physical behavior of gases. Prerequisite: exemption/completion with a C grade or better in CHEM-101 (or READ A-F and high school chemistry with advisor signature) and MATH-123. Three hours lecture, three hours laboratory, one hour conference each week. GENERAL EDUCATION

**CHEM-106**, General Chemistry 2, is a continuation of CHEM-105 for students who intend to major in chemistry, life sciences and other areas that require a minimum of one semester and/or one year of college chemistry. Topics covered in the course include the study of intermolecular forces in liquids and solids, phase changes, properties of solutions, chemical kinetics, gaseous and aqueous equilibria, acids and bases, chemical thermodynamics, electrochemistry, and introduction to nuclear, organic and biological chemistry. Prerequisite: CHEM-105 and MATH-123 with C grades or better. Three hours lecture, three hours laboratory, one hour conference each week. GENERAL EDUCATION

**CHEM-201**, Organic Chemistry 1, is the first semester course in college level organic chemistry. This course fulfills the requirements for students who are chemistry majors, life science majors or pursuing other majors that require college level organic chemistry. Topics covered in the course include foundational aspects of hydrocarbons and their select derivatives including functional groups on their structure, stereochemistry, reactions, and acid-base chemistry. Prerequisite: CHEM-106 with a grade of C or better. Three hours lecture and four hours laboratory.

**CHEM-202**, Organic Chemistry 2, is the second semester course in college level organic chemistry. This course fulfills the requirements for students who are chemistry majors, life science majors or pursuing a major that requires a two semester sequence of college level organic chemistry. Topics covered in the course include nomenclature, structural determination and mechanisms of reactions of functional groups including biomolecules. Prerequisite: CHEM-201 with a grade of C or better. Three hours lecture and four hours laboratory.

**MATH-135** Calculus of a Single Variable 1 introduces the initial concepts of both differential and integral calculus. The concept of limits will be introduced both informally and through the formal epsilon- delta process. Derivatives and integrals of polynomial, power and trigonometric functions will be developed as well as general differentiation techniques (such as the chain rule

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and implicit differentiation). Evaluation of definite integrals will be covered through limits of Riemann Sums, numerical integration techniques, and the Fundamental Theorems of Calculus. Applications of calculus to graphing and to physical situations will be extensively developed. Prerequisite: exemption/completion of READ A-F, plus MATH-123/MATH-124 or MATH-130 with C grades or better or satisfactory scores on the placement tests. Credit by exam available. Graphing calculator required. See Mathematics Department web site for details. Five hours lecture each week. Four credits. Four billable hours. GENERAL EDUCATION

**ENGL-101** College Writing develops critical reading, thinking, and writing skills. Students will use the writing process to compose academic essays that support a thesis statement, use Standard English, including proper punctuation and sentence structure, and conduct and document academic research, culminating in at least one researched-based essay. Students will compile Part 1 of a writing portfolio that will be evaluated as the final examination. In addition, students will spend an hour per week outside of the classroom engaged in Expression Workshop activities, which include student-teacher conferences, writing seminars, and online instruction in sentence-level skills. Prerequisite: ENG A-E or a score of 90 or higher on the placement test, and concurrent enrollment in, successful completion of, or exemption from READ A-F. Four hours lecture each week. Three credits. Four billable hours. GENERAL EDUCATION

**ENGL-102** Writing About Literature provides a program in critical reading and interpretive writing. Students will build on rhetorical and research skills developed in English 101 by critically reading literature from three genres, writing analytical and interpretative essays, and conducting and documenting academic research, culminating in at least one research essay. Students will also study the principles of three literary types (fiction, poetry, and drama) by reading and analyzing examples of each. Throughout the course, students will compile Part 2 of their writing portfolios, which will be evaluated as the final examination. Prerequisite: ENGL-101. Three hours lecture each week. Three credits. Three billable hours. DIVERSITY/WORLD VIEW GENERAL EDUCATION

## **2. Describe the educational objectives and intended student learning outcomes.**

The major goal of all courses in the biological sciences is to involve the student actively in the use and understanding of the scientific method, using a variety of instructional modes such as technology, analysis and interpretation of data, oral and written communication, information literacy, problem solving, and critical thinking skills. To that end, there are four program goals for the Sciences division at Carroll (below). Each of the course objectives in all science division courses have been aligned to either these science division program goal (PG) or a college general education goal (GE), or both. These alignments are listed on each course syllabus and are repeated below the table of program goals.

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**Figure 2: Table of Science Division Program Goals**

<i>Science Division Program Goals</i>
Goal 1 – Students will find, use, and assess scientific information to demonstrate scientific literacy.
Goal 2 – Students will apply scientific reasoning and concepts to problem solving situations.
Goal 3 – Students will effectively communicate scientific information in oral, written, and/or visual formats.
Goal 4 – Students will demonstrate effective teamwork skills through various collaborative learning experiences.

**Figure 3: Table of Science Division Course Objectives Mapped to Program and General Education (GE) Goals (GE goals are discussed in B.3.)**

<b>BIOL-101</b> Fundamentals of Biology 1
<p>Course Objectives:</p> <ol style="list-style-type: none"> <li>1. Relate basic chemical structures to physical structures and processes of cells recognizing molecular and cellular organization as core structure of living systems. (GE2, GE3, PG1, PG2)</li> <li>2. Compare and contrast certain metabolic pathways in plants and animals. (GE1, GE2, GE3, PG1, PG4)</li> <li>3. Use processes of cell division to explain the genetic basis of growth and reproduction. (GE1, GE2, GE3, PG1, PG4)</li> <li>4. Explain genetic expression in molecular terms. (GE1, GE3, PG4)</li> <li>5. Describe and appraise application of current genetic technology. (GE1, GE2, GE3, GE4, GE7, PG1, PG2, PG3, PG4)</li> <li>6. Explain how evolution is a unifying thread in biology. (GE1, GE2, GE3, PG1)</li> <li>7. Engage in collaborative laboratory activities, formulate hypotheses, collect and interpret data, and communicate conclusions in written, oral, or visual formats. (GE1, GE2, GE3, GE4, GE5 PG1, PG2, PG3, PG4)</li> <li>8. Research and present information on selected topics using various modes of communication (oral, written, and visual). (GE1 PG1, PG2, PG3)</li> </ol>
<b>BIOL-102</b> Fundamentals of Biology 2
<p>Course Objectives:</p> <ol style="list-style-type: none"> <li>1. Recognize the concepts underlying the principles of evolution, natural selection, and population genetics. (GE3, PG1)</li> <li>2. Describe the origin, evolution, and characteristics of organisms from the three domains and major phyla of life. (GE1, GE2, GE3 PG1, PG2)</li> <li>3. Relate the phylogenies of plants and animals to the development of key variations and adaptations in response to environmental influences. (GE2, GE3 PG1, PG2, PG4)</li> <li>4. Explore the evolutionary patterns and strategies of growth and reproduction of different plant and</li> </ol>



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- animal divisions emphasizing the relationship of form and function. (GE3 PG1,PG2)
5. Describe the dynamics of populations and community structures. (GE1,GE2,GE3 PG1,PG2)
  6. Recognize and describe the biotic and abiotic relationships in ecosystems and human impact. (GE1,GE2,GE3,GE6,GE PG1,PG2)
  7. Formulate hypotheses, collect and interpret data, and communicate conclusions. (GE1,GE2,GE3,GE4 PG1,PG2,PG3,PG4)
  8. Research and present information on selected topics using various modes of communication (oral, written, visual). (GE1 PG1,PG2,PG3)

**BIOL-215 Microbiology**

**COURSE OBJECTIVES:**

1. Discuss the structure of microorganisms and relate those structures to pathogenicity and control of infection. (GE1, GE2, GE3, PG2, PG 3)
2. Describe ways in which microorganisms and their environment interact with and modify each other. (GE1, GE2, GE3, PG2, PG3)
3. Examine microbial growth requirements and metabolism and relate to physical, chemical and antimicrobial control of microbial populations. (GE1, GE3, PG2, PG3 )
4. Explain how genetic variations and gene expression can impact microbial growth and function (GE1, GE3, PG2, PG3)
5. Describe microbial evolution and diversity in terms of mutations, gene transfer, and human environmental influences (GE1, GE2, GE3, PG2, PG3)
6. Describe ways in which humans utilize and harness microorganisms and their products (GE1, GE2, GE3, PG2, PG 3)
7. Explain nonspecific body defenses and the immune responses and apply this understanding to the infectious disease process as well as the prevention and control of infectious diseases. (GE1, GE3, PG3)
8. Effectively communicate fundamental concepts of microbiology through independent research of credible scientific sources. (GE1, GE4, PG1, PG3)
9. Develop an information base for personal and global health decisions in regard to infectious diseases. (GE2, GE3, GE4, GE6, GE7, PG2)
10. Demonstrate appropriate laboratory safety, skills, and techniques related to the isolation, staining, identification, assessment of metabolism, and control of microorganisms. (GE2, GE3, GE4, PG2)
11. Develop the ability to work both independently and with others in the laboratory to communicate appropriate conclusions from laboratory experiences and case studies. (GE2, GE3, GE4, PG1, PG2, PG3, PG4)

**BIOL-240 Genetics**

**Course Objectives:**

1. Identify the major milestones in the history of genetics. (GE N/A,PG1)
2. Compare the different forms of inheritance patterns in Mendelian and population genetics. (GE1,2,3 PG2,3)
3. Use and interpret probabilities and statistics in the analysis of genetic data and pedigrees. (GE2,3 PG2)

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4. Explain and apply the techniques of eukaryotic gene mapping. (GE1,2,3 PG2,3)
5. Describe the cellular and chemical events during the eukaryotic cell cycle. (GE1,2,3 PG2,3)
6. Explain the mechanisms of genetic variation in sexually reproducing organisms (GE1,2,3 PG2,3)
7. Describe the processes of gene expression (GE1,2,3 PG2,3)
8. Analyze the various types of mutations and describe their social impacts (GE1,2,4,6 PG1,2,3)
9. Explain the major methods and demonstrate techniques used in research and biotechnology. (GE1,2,3 PG2,3,4)

**CHEM-105** General Chemistry 1

Course Objectives:

1. Solve various chemistry problems using the metric system, using proper mathematical and problem-solving skills with the aid of non-graphing and non-programmable calculators. (GE2, PG1, PG2)
2. Describe the nature of matter and atomic theory and its relevance. (GE2, GE3, PG1)
3. Apply proper nomenclature and formulas in writing balanced reactions and solve stoichiometric problems. (GE2, GE3, PG1, PG2)
4. Qualitatively and quantitatively describe and predict the reactions of chemicals, and perform thermochemistry analyses of these reactions. (GE3, PG1, PG2)
5. Describe and analyze the behavior of gases, and apply the laws that govern these behaviors in problem-solving. (GE2, PG1, PG2)
6. Explain and interpret the periodic trends of elements and electron configuration. (GE2, GE3, PG1, PG2)
7. Predict and formulate the bonding of atoms and molecular geometry of compounds. (GE2, GE3, PG1, PG2)
8. Perform collaborative laboratory explorations to reinforce understanding of chemical concepts, develop mastery in proper measuring techniques and laboratory report writing and relate lab experience to applications of chemistry in daily life. (GE1, GE3, GE4, GE7, PG1, PG2, PG3, PG4)
9. Research and present information on selected topics from the course using various modes of communication (oral, written, and visual). (GE1, GE4, GE5, GE6, GE7, PG1, PG3, PG4)

**CHEM-106** General Chemistry 2

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Course Objectives:

1. Recognize, relate and explain the properties that affect liquids and solids and influence their change of state. (GE2, GE3, PG1, PG2)
2. Describe the factors that affect solutions and solve math related problems. (GE2, PG1, PG2)
3. Explain chemical kinetics and the effects on chemical reactions. (GE2, GE3, PG1, PG2)
4. Describe the factors that affect chemical equilibria and solve math related problems. (GE2, GE3, PG1, PG2)
5. Understand chemical reactions that involve acids and bases, their effects and solve pH for buffer systems and acid-base equilibria. (GE2, GE3, PG1, PG2)
6. Predict and solve spontaneous reaction based on states, enthalpy, entropy and free energy of reactions. (GE2, GE3, PG1, PG2)
7. Solve oxidation-reduction and electrochemical reactions to predict spontaneous and non-spontaneous reactions. (GE2, GE3, PG1, PG2)
8. Recognize the process involving select nuclear reactions (including half lives and curies), nomenclature of organic chemistry (including different functional groups) and biological chemistry with relevance to interactions with such compounds. (GE2, GE3, GE7, PG1, PG2)
9. Perform collaborative laboratory explorations to reinforce understanding of chemical concepts, develop mastery in proper measuring techniques and laboratory report writing and relate lab experience to applications of chemistry in daily life. (GE1, GE3, GE4, GE7, PG1, PG2, PG3, PG4)
10. Research and present information on selected topics from the course using various modes of communication (oral, written, and visual). (GE1, GE4, GE5, GE6, GE7, PG1, PG3, PG4)

**CHEM-201** Organic Chemistry 1

Course Objectives:

1. Recognize and name major classes of organic compounds such as alkanes, alkenes, alkynes, organohalides, alcohols, and phenols. (PG1)
2. Explain the relationship between bonding and acids and bases. (GE2, GE3, PG1, PG2)
3. Explain the role of stereochemistry for select hydrocarbons such as alkanes and cycloalkanes. (GE2, GE3, PG1, PG2, PG3)
4. Describe the relationship between structures and reactions for select hydrocarbon and their derivatives such as alkanes, alkenes, alkynes, organohalides, alkyl halides, alcohols and phenols. (PG1, PG2, PG3)
5. Propose reactions mechanisms correctly by different types such as nucleophilic substitutions and elimination to formulate multi-step organic syntheses. (GE2, GE3, GE5, PG1, PG2, PG3)
6. Describe the principles involving methods of structure determination such as GC,MS,IR,UV and NMR. (GE2, GE3, PG1, PG2, PG3)
7. Perform collaborative laboratory explorations to reinforce understanding of chemical concepts, develop mastery in proper measuring techniques and laboratory report writing and relate lab experience to applications of chemistry in daily life. (GE1, GE3, GE4, GE7, PG1, PG2, PG3, PG4)
8. Research and present information on selected topics from the course using various modes of communication (oral, written, and visual). (GE1, GE4, GE5, GE6, GE7, PG1, PG3, PG4)

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**CHEM-202 Organic Chemistry 2**

Course Objectives:

1. Recognize and name organic compounds including functional groups such as alcohols, phenols, aldehydes, ketones, carboxylic acids, amines, carbohydrates, amino acids and lipids. (PG1)
2. Explain the reactions between aromatic compounds and select functional groups. (GE2, GE3, PG1, PG2, PG3)
3. Describe the relationship between structures and reactions for select functional groups using different bonding models discussed in general chemistry. (GE2, GE3, PG1, PG2, PG3)
4. Propose reactions mechanisms correctly for different functional groups. (GE2, GE3, GE5, PG1, PG2, PG3)
5. Describe the principles involving structural determination and reactions of select biomolecules such as carbohydrates, amino acids and lipids. (GE2, GE3, PG1, PG2, PG3)
6. Propose reaction mechanisms and structural determination of organic compounds with functional groups learnt in this course using the spectroscopic methods of analysis learnt from the first semester of organic chemistry such as GC, MS, IR and NMR. (GE2, GE3, GE4, PG1, PG2, PG3)
7. Perform collaborative laboratory explorations to reinforce understanding of chemical concepts, develop mastery in proper measuring techniques and laboratory report writing and relate lab experience to applications of chemistry in daily life. (GE1, GE3, GE4, GE7, PG1, PG2, PG3, PG4)
8. Research and present information on selected topics from the course using various modes of communication (oral, written, and visual). (GE1, GE4, GE5, GE6, GE7, PG1, PG3, PG4)
8. Write clear and complete sentences without errors that impede meaning (GE1 E5)
9. Exercise reflective learning habits established in English 101 (GE1, GE2, GE6 GE7)

**3. Discuss how general education requirements will be met, if applicable.**

Carroll Community College has 7 General education goals meeting COMAR regulations (Figure 4). Each course in the proposed program of study has had its course objectives mapped to these GE goals (Figure 3). Courses outside of the Sciences division, but included in the proposed program of study, have their GE goals reported in Appendix B.

The required 30 General Education credits are so noted on the program outline (Figure 1).

*Figure 4: Table of General Education Learning Goals Assessment Plan*

<p><b>1. Communication (Written and Oral)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.</p> <ul style="list-style-type: none"><li>• Assess and address a specific audience to accomplish a goal</li><li>• Craft an arguable thesis statement and support it with evidence</li><li>• Explore and respond to differing perspectives</li><li>• Use standard English in academic and professional settings</li></ul>
<p><b>2. Critical Thinking</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.</p> <ul style="list-style-type: none"><li>• Independently identify problems and pose questions</li><li>• Gather, read, evaluate, and integrate relevant information</li><li>• Explore alternative perspectives and their implications</li><li>• Draw well-reasoned conclusions</li></ul>
<p><b>3. Quantitative and Scientific Reasoning</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.</p> <ul style="list-style-type: none"><li>• Apply models and methods to define, represent, and solve mathematical and scientific problems</li><li>• Make observations, identify problems, formulate questions and hypotheses</li><li>• Collect and interpret data in order to draw valid conclusions and identify logical relationships</li><li>• Distinguish scientific arguments from non-scientific arguments</li></ul>
<p><b>4. Information &amp; Technology Literacy</b> Students will research, create, and communicate information through appropriate technology.</p> <ul style="list-style-type: none"><li>• Select appropriate search methods for gathering information</li><li>• Evaluate the authority, reliability, accuracy, and currency of information sources</li><li>• Demonstrate an awareness of the ethical, legal, and cultural issues and responsibilities in the uses of information and technology</li><li>• Design, develop, and produce media that effectively communicate information and ideas</li></ul>
<p><b>5. Creativity</b> Students will explore and appreciate the creative processes that shape the human experience.</p> <ul style="list-style-type: none"><li>• Appreciate creative expression as a reflection of culture and history</li><li>• Identify how creative processes lead to discovery and innovation</li><li>• Define and analyze stylistic nuances in artistic forms</li><li>• Examine a significant work of art or great idea and its cultural influence</li></ul>

**6. Global Awareness**

Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment.

- Analyze and evaluate the significance of cultures and societies from a variety of perspectives
- Explain the impact of economic, political, and technological changes on diverse cultures
- Examine the interdependence of humanity
- Appreciate the commonalities and the differences among world cultures

**7. Personal Development and Social Responsibility**

Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.

- Develop a framework for ethical decision making and personal responsibility
- Examine how personal behaviors affect self and others
- Collaborate with others to achieve a common goal
- Participate in and reflect on personal learning experiences

**4. Identify any specialized accreditation or graduate certification requirements for this program and its students.**

There are no specialized accreditation or graduate certification requirements for this program. Students who complete this program would receive an AS in biology from Carroll Community College.

**5. If contracting with another institution or non-collegiate organization, provide a copy of the written contract.**

At this time we have no agreements with other educational institutions or local applicable business that are interested in providing cooperative education opportunities.

**C. Critical and compelling regional or Statewide need as identified in the State Plan:**

**1. Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the state in general based on one or more of the following:**

- \*The Need for the advancement and evolution of knowledge:
- \*Societal needs, including expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education;
- \* The need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs.

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The AS degree in biology has been envisioned to meet the specific needs for supporting STEM-related fields. According to the Bureau of Labor Statistics, the mid-Atlantic region, specifically Maryland and Washington DC, represents a growing market for STEM related careers.

Carroll Community College's (CCC) population is 64% female. Minorities account for 8% of the student population. First generation college students, with neither parent having attended college, are 26%. CCC serves approximately 340 students with disabilities, making up 9% of credit student population. CCC serves veterans. Obtaining an accurate count is not viable as enrollment forms do not require that students report their military status (Maryland Higher Education Commission, 2015).

**2. Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education.**

Quality and Effectiveness – Carroll Community College is a public, open admission, associate-degree-granting college serving Carroll County with baccalaureate preparation programs, career education, workforce and business development, and personal and cultural enrichment opportunities. CCC is a vibrant, learner-centered community that actively engages students, preparing them for an increasingly diverse, changing, and often challenging world. Enrollment at CCC is approximately 3,800 credit students and 7,750 non-credit students. (MACC databook, 2015). Approximately 45% of Maryland undergraduate students within Carroll County enroll at Carroll (Maryland Higher Education Commission, 2015).

Access, Affordability, and Completion – Since 1990, Carroll Community College (CCC) has grown from a branch of a neighboring county's community college into an independent college with 60 credit programs and transfer recommendations. CCC boasts a greater than average 80% retention rate, with 95% of graduates reporting employment in a field related to their degrees or continuing education program (National Student Clearing House, 2014) (CCC Institutional Research, 2013). In 2008, CCC was named one of the top tech-savvy community colleges in the nation by the Center for Digital Education and the American Association of Community Colleges (AACC). In 2010, CCC received the National President's Honor Roll recognition for Service-Learning, the highest federal recognition a college can receive for its commitment to volunteering, service-learning, and civic engagement.

Diversity – Carroll Community College serves large female populations, representing 64% of CCC's credit student population. Only eight percent of students account for CCC's minority population. Twenty-six percent of students are first generation college students, with neither parent having attended college. CCC serves approximately 340 students with disabilities, making up nine percent of credit student population.

**D. Quantifiable & reliable evidence and documentation of market supply & demand in the region and State:**

**1. Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.**

According to most recent indicators provided by the United States Bureau of Labor Statistics (BLS) and related market data websites, demand for professionals holding a biology degree will remain strong (*Healthcare occupations*, 2016; *Occupational outlook handbook*, 2016). The BLS reports that demand for entry level biological-related jobs will continue to increase from an average of 9-20% throughout the decade ending in 2024 with allied-health related job experiencing faster growth. In addition to health related job growth, the American Institute of Biological Sciences indicates that professionals with degrees and experience in biological fields related to molecular biology and biotechnology will also remain in high demand (*What is the job outlook*, n.d.).

Regional data (*Economic modeling*, 2016) indicates that there was a steady rise in biology-related jobs from 2013 to Oct 2015. Including the counties in Maryland within a commute of 40 miles, job opportunities have increased from 474 unique job postings in the sciences to 636 through 2015. Supporting the expansion of future growth in these areas, regional data compiled from U.S. governmental agencies indicate that career opportunities as a Biological Technician, Medical Equipment Technician, Medical Technologist, and Food Science Technician will experience continued growth of approximately 10% through 2024 (*Industry data*, 2016). Specifically in the Baltimore, Carroll, and Frederick County regions, the Department of Labor, Licensing and Regulation Workforce Region Industry Projections for the years 2012 – 2022 (*Workforce*, 2015) indicate promising growth in the fields supported by advancing workforce education in the life sciences. Occupations in the Allied Health fields as well as natural sciences are expected to grow overall from 9 to 24%. The average for Baltimore regions science-related job growth is projected to approach a near 20% across related professions. In the Frederick region job growth in related science occupations is expected to exceed 20% growth by 2022.

The College supports regional growth and opportunities for students seeking jobs in the life sciences through advancing programs such as this proposed degree, as well as actively supporting student opportunities through a highly active, visible, and successful career development program. The College hosts an annual general job fair attended consistently by at least 15 different potential life science employers located regionally. Additional job fairs are held for Physical Therapist Assistant students in October attended by up to 15 distinct recruiting employers. In January 2016, an employment event focused on jobs in nursing drew the participation of 16 distinct recruiters. In addition to these events, providers utilize individual recruiting events, such as setting up an information table in the cafeteria (about 12 per year). Lastly, 42 healthcare companies are registered on the College's online job board and offer employment as well as internship opportunities for our students. Not only will this degree meet



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regional needs for growing opportunities in the biological sciences it will also be actively supported by our reputable and successful career development program

**2. Discuss and Provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.**

A White House report in 2012 indicated that STEM fields will need over a million workers to keep up with demand. The associate of science in biology degree supports sustained professional growth and increased opportunity for professionals interested in applying their STEM aspirations in a biological field (*Community colleges*, 2016). In a number of career paths, an associate degree in biology can leverage the competitive edge, as well as provide entry level qualifications leading to further professional opportunities. (See table in Fig 5)

The projected data summarized in the table below (Fig 5) indicates that throughout the decade ending in 2024, there will be a wide array of opportunities for individuals who complete an Associate degree in a specific life science area, such as biology. While a Bachelor’s degree is generally necessary for advancement, the following chart reveals strong market indicators that support the AS degree for entry level positions. The BLS data suggests that the need for biology majors who will continue professional development in healthcare, biotechnology, and other laboratory settings will remain robust throughout the decade. Regionally, opportunities are expanding. (See D.1)

According to the Maryland Department of Commerce, “The state represents one of the largest life sciences clusters in the U.S. with 500+ biotech firms, 2000 life science companies, the NIH, the FDS, Johns Hopkins University, the University of Maryland, and plenty of funding and guidance resources” (*Maryland biohealth story*, 2016). Our proposed degree complements the state-level emphasis on cultivating existing and actively perpetuating in-state biology-related opportunities for graduates of regional educational institutions.

**Figure 5: Table of Entry Level Positions Requiring an Associate Degree**

Occupation	Description of tasks	Entry-Level Education	Median Salary
Agricultural and Food Science Technicians	Measure and analyze the quality of food/ agricultural products; prepare reports	Associate –“Agricultural and food science technicians typically need an associate degree in <u>biology</u> , chemistry, crop or animal science, or a related field.” BLS	\$35, 140
Environmental Science	Monitor the environment; investigate causes of	Associate – depending on the chosen area of interest a related associate degree in	\$42, 190

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and Protection Technician	pollution/contamination; assist in investigating public health violations	biology, chemistry, or environmental science is recommended.	
Veterinary/ animal research assistant	Assist in care and rehabilitation of animals	While some employers allow GED or equivalent, advancement will require further education; and associate degree in the chosen field will support professional development in this career path.	\$23,790
Medical Assistants- entry level caregivers; related medical entry positions	Assist in the care and rehabilitation of people across all demographic sectors	While some employers allow specialized certificates or equivalent for entry, advancement will require further education; the associate degree in biology will support professional development in this career path.	\$29,960
Entry level zoo and aquarium jobs	Assist in conservation, care, education, and protection related to animals in captivity ( <i>Career outlook</i> , 2016)	Advancement toward the bachelor's degree is supported by the associate degree in biology.	\$37,000
Entry level field work in Biology (aides)	Private and public sector jobs for laboratory and/or field work aides allow students to gain entry level experience while completing further education needed for advancement.	The associate degree in biology can help leverage the competitive edge while gaining experience and advancing education in this field. The Office of Personnel Management (OPM) for the Federal Government provides "Student Trainee" positions in many fields where students enrolled in a degree program in their field are eligible for special employment to gain experience in the field. The associate degree in biology will support this career opportunity (USAJobs, n.d.)	generally hourly 10+/hour ( <i>Biological aide</i> , 2016)

**3. Data showing the current and projected supply of prospective graduates.**

In accordance with advising protocol at Carroll, students are asked to identify a major area of study. Of incoming spring 2016 students, 16.6% (512 of 3,083) indicated an interest in pursuing a biology related course of study. In addition, 6 sections of current biology students were polled to see whether they would consider switching to an AS biology degree if it were offered by the college. Sixty-four students of 121 responded "yes."

Carroll County census and population forecasts project a nearly flat population increase from 167,349 individuals in 2015 to 168,687 individuals in 2020. There is a slight projected decrease in Carroll county high school graduates, 1,985 in AY 2015-2016 to 1,948 projected for AY 2020-2021. If 15 to 16% of those incoming students enroll for the AS degree in biology, the program will easily support itself and continue to benefit both the College and the community.

**E. Reasonableness of program duplication**

**1. Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.**

Of the 16 community colleges in Maryland, those within a 50 mile driving radius of Carroll Community College include 8 colleges plus the Gettysburg, PA campus of Harrisburg Community College. Of these 9 community colleges which share an overlapping student base, only four offer an associate of science option instead of the more common associate of arts degree. None offer a designated degree in biology. Where the associate of science degree is offered, it is most common to have a general life science path. This proposed degree at Carroll Community College will offer students a designated associate degree in biology.

The proposed associate of science degree in biology will prepare students for further study or entry level positions (see part D). In addition it will provide another option for regional students who already know they wish to pursue a career in biology. This degree option will be a stronger choice for biology pathways after graduation. Taking into account the strong regional growth in life science-related jobs expected through 2024 (see part D), students participating in life science degree courses may leverage the competitive edge as the expansion of jobs in this area continue to grow.

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**2. Provide Justification for the proposed program.**

Please see part D. In addition to the regional and national need for well-prepared biology professionals in a wide range of professional settings, this program offers a stronger degree choice for students entering into college already certain of their career path. Those already in a career may need additional coursework in the life sciences in order to retain the competitive edge as opportunities for advancement in these fields increase with projected expectations. Regionally, opportunities in biology are growing and represent an active and aggressive state-wide initiative to grow the life science career options and keep highly talented professionals within the state. Moving forward with our biology degree would support the alignment of our academic programs with the statewide and regional employment goals and opportunities unfolding over the next couple decades. The adoption of this degree program will allow our students to meet personal career benchmarks, as well as contribute to a strong talent pool for state-level commerce goals and support regional growth in our county. This degree program will also support diversity goals of the College. Women and other under-represented groups in the sciences will have an additional regional opportunity to build marketable skills in the STEM fields through the adoption of this degree program.

**Figure 6: Table of Surrounding Community Colleges with Comparable Degrees**

College	Degree
Alleghany Community College	Associate of Arts
Anne Arundel Community College	Associate of Science
Baltimore City Community College	Associate of Arts
Community College of Baltimore	Associate of Arts
Carroll Community College	Associate of Arts
Cecil College	Associate of Science
Chesapeake College	Associate of Science
College of Southern Maryland	Associate of Science
Frederick Community College	Associate of Science
Garrett College	Associate of Arts
Hagerstown Community College	Associate of Science
Harford Community College	Associate of Science

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Howard Community College	Associate of Arts
Montgomery College	Associate of Science
Prince George's Community College	Associate of Arts
Wor-Wic Community College	Associate of Science
Harrisburg, PA Gettysburg Campus	Associate of Arts

**F. Relevance to Historically Black Institutions**

- 1. Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBI's**

The AS in biology should have no impact on high-demand programs at HBIs.

- 2. Discuss the program's potential impact on the uniqueness and institutional identities and missions of HBI's**

The AS in biology should have no impact on uniqueness and institutional identities and missions of HBIs.

**G. If proposing a distance education program, please provide evidence of the Principles of Good Practice**

There are no current plans or efforts to offer the program by distance learning at this time. Some general education components of the AS program are presently offered in distance formats.

**H. Adequacy of faculty resources**

The new program will not require any new faculty resources for the College. The only new course added to the curriculum is BIOL-240, Genetics. This course will be staffed by current faculty. This program would be overseen and course assignments made, by Carroll Community College's Life Sciences Discipline Coordinator (LSDC), Dr. Lena Garrison, in conjunction with the Sciences Division Chair, Dr. Raza Khan. The discipline coordinator and the chair manage, supervise, and provide quality oversight over all biology course offerings—personnel, budget, curriculum design, course and program assessment, and college activities involving student field and research experiences.

Appendix A includes the academic credentials of individuals who have the skill set and experience to serve as faculty for these class offerings. All full-time faculty teaching in the Science Division possess earned masters or doctoral degrees in their respective fields, and are

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veteran post-secondary science educators. Furthermore, Science faculty maintain a strong presence in their respective professional and academic fields, as well, attending and presenting at numerous local, state, and national conferences, workshops, and symposia. A large cadre of adjunct instructors, highly qualified in their fields, rounds out the faculty in the Science Division.

## **I. Adequacy of library resources**

**Library Resources** – the library already provides a strong collection to support the AS in biology degree program. Only \$200.00 of additional library resources are requested in the first year to implement the program. Moving forward the resource collection will grow annually as a part of the current library resource acquisition plan of the College.

Those requested resources include:

- Cobb, Matthew *Life's Greatest Secret: The Race to Crack the Genetic Code.*
- Field, Dawn *Biocode: The New Age of Genomics.*
- Gibson, Greg *A Primer of Human Genetics.*
- Moalem, Sharon *Inheritance: How Genes Change our Lives -- and our Lives Change our Genes.*
- Slack, Jonathan *Genes: A Very Short Introduction.*

**Library Support** - Librarians have supported and assisted the science faculty and curriculum in numerous ways over the last five years. Some of the ways in which librarians contributed to the science program at Carroll include:

***Embedded Librarianship*** - Embedded librarians assist faculty by establishing a presence on a faculty member's Blackboard page and assisting students at their point of need.

***Library Instruction and Instructional Support*** - Librarians teach library instruction sessions for science classes and make brief visits to individual classrooms to discuss documentation and to introduce resources in an informal manner. Librarians have also consulted with faculty on instructional design and planning for assignments.

***Subject Research Guides*** - Librarians have created and currently support 5 Subject Research Guides relating to the sciences. These include Subject Research Guides for Biology, Chemistry, Geoscience, Environmental Sciences, and one combined guide for Physics, Physical Sciences, and Astronomy.

***Collection Development*** - Librarians have worked with faculty to develop the Library's print and electronic science collection. Since 2007, librarians have purchased 993 titles in the sciences, own approximately 3200 volumes, and have circulated 2595 items in that subject area. Librarians have two online databases dedicated to the sciences (ProQuest Biology Journals and McGraw Hill's Access Science) as well as two multidisciplinary (EBSCO's Academic Search

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Premier and Master File Premier) and a News database (ProQuest Newspapers) that cover science topics for both general and academic audiences. Librarians regularly solicit science faculty for titles and resources to strengthen the collection. The science collection is continually updated and evaluated based on circulation of titles and currency of materials. New acquisition lists are shared with science faculty on a monthly basis.

**Reference Assistance** - Librarians provide science students with in-person, phone-based, and electronic assistance at the reference desk, help them find and evaluate resources for research projects, and document those sources. Librarians often provide individual instruction in using resources during reference transactions.

**Academic Center** - The Science Department has worked with the Academic Center to promote tutoring for biology, chemistry, physics, and anatomy and physiology students.

#### **J. Adequacy of physical facilities , infrastructure and instructional equipment**

Carroll Community College complies with the American with Disabilities Act and has the necessary infrastructure and instructional equipment for ADA accommodations. The Office of Student Support Services provides the evaluations for ADA accommodations.

Carroll Community College classrooms are equipped with the latest and updated instructional equipment which includes: computers, audio and visual devices which includes projectors. Carroll's Information Technology department supports this equipment with software updates and any maintenance or repairs necessary to maintain quality instruction.

Recent conversions of classrooms into laboratory rooms have been made. Currently, the laboratories in the C, K, M, and A buildings support all the science courses that have a lab component.

Current physical facilities and infrastructure at Carroll Community College are adequate to offer the new degree program without the need for additional resources.

Computers are available for student, faculty and staff use in classrooms, computer labs, and the library. Free printing and wireless internet access can be found in all those locations.

The Testing Center is available to instructors for students with disability accommodation needs.

The advising staff provides course information that will assist students interested in pursuing study of biology.

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**K. Adequacy of financial resources with documentation (as outlined in COMAR 13B.02.03.14)**

**1. Complete Table 1: Resources (pdf) and Table 2: Expenditure (pdf). Finance data (pdf) for the first five years of program implementation are to be entered. Figures should be presented for five years and then totaled by category for each year.**

**2. Provide a narrative rationale for each of the resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.**

*Figure 7: Table of Resources*

Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Reallocated Funds <sup>1</sup>	\$0	\$0	\$0	\$0	\$0
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	\$51,969.6	\$69,292.80	\$103,939.20	\$103,939.20	\$103,939.20
a. #F.T Students	6	8	12	12	12
b. Annual Tuition/Fee Rate	\$4812	\$4812	\$4812	\$4812	\$4812
c. Annual Full Time Revenue (a x b)	\$28,872	\$38,496	\$57,744	\$57,744	\$57,744
d. # Part Time Students	12	16	24	24	24
e. Credit Hour Rate	\$160.40	\$160.40	\$160.40	\$160.40	\$160.40
f. Annual Credit Hours	12	12	12	12	12
g. Total Part Time Revenue (d x e x f)	\$23,097.60	\$30,796.80	\$46,195.20	\$46,195.20	\$46,195.20
3. Grants, Contracts, & Other External Sources <sup>3</sup>	\$0	\$0	\$0	\$0	\$0
4. Other Sources	\$0	\$0	\$0	\$0	\$0
<b>TOTAL (Add 1 - 4)</b>	<b>\$51,969.6</b>	<b>\$69,292.80</b>	<b>\$103,939.20</b>	<b>\$103,939.20</b>	<b>\$103,939.20</b>

<sup>1</sup> Whenever reallocated funds are included among the resources available to new programs, the following information must be provided in a footnote: origin(s) of reallocated funds, impact of the reallocation on the existing academic program(s), and manner in which the reallocation is consistent with the institution's strategic plan.



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<sup>2</sup> This figure should be a realistic percentage of tuition and fees which will be used to support the new program. Factors such as indirect costs linked to new students and the impact of enrolling continuing students in the new program should be considered when determining the percentage.

<sup>3</sup> Whenever external funds are included among the resources, the following information must be provided in a footnote: source of the funding and alternative methods of funding the program after the cessation of external funding.

**TABLE 1: Resources Narrative Explanation**

**1. Reallocated Funds**

At this time there are no funds being reallocated for this program.

**2. Tuition and Fee Revenue:**

Enrollment projections were based on a small sample from area community colleges. The Community College of Baltimore County and Howard Community College reported that approximately 1% of the total credit students enrolled at their respective colleges sought an associate degree in biology. Carroll Community College's current credit student enrollment is 3090. Therefore, approximately 31 students will be seeking a degree in biology in the upcoming academic year. Currently, 67% of these students are enrolled part-time while 33% are enrolled full-time. It is anticipated that this program will bring in an excess of \$100,000 annually even with a steady decline in overall college enrollment.

**3. Grants, Contracts & Other External Sources**

No grants, contracts or other external sources have been acquired.

**4. Other Sources:**

No additional funds have be allocated for this program

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**Figure 8: Table of Expenditures**

Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses (b + c below)	\$0	\$0	\$0	\$0	\$0
a. # FTE	\$0	\$0	\$0	\$0	\$0
b. Total Salary	\$0	\$0	\$0	\$0	\$0
c. Total Benefits	\$0	\$0	\$0	\$0	\$0
2. Total Administrative Staff Expenses (b + c below)	\$0	\$0	\$0	\$0	\$0
a. # FTE	\$0	\$0	\$0	\$0	\$0
b. Total Salary	\$0	\$0	\$0	\$0	\$0
c. Total Benefits	\$0	\$0	\$0	\$0	\$0
3. Total Support Staff Expenses (b + c below)	\$0	\$0	\$0	\$0	\$0
a. # FTE	\$0	\$0	\$0	\$0	\$0
b. Total Salary	\$0	\$0	\$0	\$0	\$0
c. Total Benefits	\$0	\$0	\$0	\$0	\$0
4. Equipment	\$3956	\$3426	\$1466	\$1466	\$1466
5. Library	\$200	\$0	\$0	\$0	\$0
6. New or Renovated Space	\$0	\$0	\$0	\$0	\$0
7. Other Expenses	\$0	\$0	\$0	\$0	\$0
<b>TOTAL (Add 1 - 7)</b>	<b>\$4156</b>	<b>\$3426</b>	<b>\$1466</b>	<b>\$1466</b>	<b>\$1466</b>

**TABLE 2: Expenditures Narrative Explanation**

**1. Faculty**

At this time, all courses necessary for this program will be instructed by current full-time or adjunct faculty

**2. Administrative staff**

No new administrative staff are required for this program

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**3. Support Staff**

No new support staff will be necessary for this program

**4. Equipment**

The equipment listed is for Genetics which will be a new course to this campus. Equipment required to offer Genetics includes a thermal cycler, mini and micro-centrifuges, gel electrophoresis systems, and various biological kits that provide applications of genetic concepts (a complete equipment breakdown is presented in Appendix C).

**5. Library**

The library at Carroll Community College currently has a vast assortment of resources to support the biology courses. Minimal additional library resources will be requested to support BIOL-240, Genetics. This will be a new on-campus course.

**6. New and/or Renovated Space**

No new and/ or renovated space is anticipated at this time. Current lab spaces are sufficient to house all lab courses for the program.

**7. Other Expenses**

No additional expenses are anticipated at this time

**L. Adequacy of provisions for evaluation of program (as outlined in COMAR 13B.02.03.15).**

**A. Evaluation of courses and faculty by students, administrators, and departmental personnel.**

To ensure that the Science Division has established courses that are in alignment with the College's mission and general education goals, the Science Division undergoes ongoing evaluation of courses, faculty, and curriculum. Faculty are given the opportunity to reflect upon professional achievements both inside and outside the classroom through an annual self-evaluation process. The faculty self-evaluation includes an analysis of teaching and learning enhancement, professional development, and objectives and goals for the future. Faculty gather data from student evaluations. Annual student evaluations include SIRS or a science division evaluation form. Each assesses student perceptions of each science course. From the student evaluations, instructors gain suggestions for improving teaching in many areas including course organization and planning, communication and student interaction, assignments and grading, course outcomes, student effort and involvement, course difficulty and pace. Through this process, students are afforded the opportunity to offer suggestions for teaching and course

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improvement. Moving forward, data from alumni surveys and focus groups will also be used to inform the curriculum design and improvement process.

The College provides opportunities and support for professional development and curriculum improvement. The College offers professional development sessions addressing student learning, curriculum, and assessment on a regular basis. Faculty receive funding for off campus professional development conferences. Faculty may choose to develop or improve curriculum as part of the promotion process. Alternatively, faculty may receive funding for curriculum development through the Summer Stipend to Improve Student Learning (SSIL) grant.

**B. Curriculum review procedures established by an institution for its program offerings shall:**

- a. Include standards and guidelines for the assessment of student outcomes as defined for the program**
- b. Be consistent with the institutional mission; and**
- c. Be specified by the institution**

The Science Division has established four program goals that are assessed on an annual basis in an Annual Report (Appendix D provides an example). Data from this Annual Report of program goals is compiled and assessed every 5 years in a comprehensive Program Review (Appendix E provides an example). Following the administration of each annual report, faculty in the Science Division meet to analyze and explain the results, to discuss revisions to the assessment tool, and to suggest ways to improve student learning, as measured by the given assessment. The purpose of this review is to evaluate the effectiveness of the Division through the evaluation of curriculum, faculty, and student learning outcomes and to ensure:

- 1) the mission of the College and the needs of the community continues to be met.
- 2) student performance is sustained at a high level and, if not, continues to improve.
- 3) transferability and/or workforce applicability continues to be its focus.
- 4) resources are appropriately identified to help support its efforts.

Every five years, programs are scheduled for a comprehensive 5-year program review. Once a comprehensive review has been completed, annual reports will update data and identify changes to the recommended plan of action. The Annual Reports and Program Review assist in formulating curriculum and budget requests. The last 5-year program review in the Sciences Division was completed in 2012 and can be viewed in Appendix E.

**M. Consistency with the State's minority student achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education).**

Minority student success in STEM programs is an extension of Diversity and World View Strategic Improvement Plan at Carroll Community College. The central mission of this plan is to

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embrace an increasingly diverse and changing world, encourage all individuals at CCC to value diversity, cultivate global awareness, and promote social justice. This mission is achieved, in part, by a General Education Goal that specially addresses global awareness. Further, the college monitors the racial and ethnic diversity of employees and students through internal research and various reports to MHEC such as the Annual Performance Accountability Report and the Minority Achievement Progress Report. Through these evaluation processes, the college is able to evaluate its progress in this area.

Carroll Community College credit student body is represented by 88% white students, 4% African American, and 8% other ethnicities. The demographics of students currently enrolled in STEM programs at Carroll Community College are 85% white, 5% Black or African American, and 10% other ethnicities. This is representative of the student body as a whole.

**N. Relationship to low productivity programs identified by the Commission:**

Not Applicable

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**Appendix A: Credentials for Potential Faculty**

**FULL-TIME FACULTY**

**Dr. Jamshed Ayub**

*Assistant Professor, Chemistry*

B.Sc., Aligarh M. University

M.Sc., Aligarh M. University

M.S., Old Dominion University

Ph.D., Old Dominion University

**Ms. Joyce C. Davis**

*Assistant Professor, Biology*

B.A., University of Maryland, College Park

M.S., McDaniel College

**Mr. François P. Derasse**

*Professor, Biology and Chemistry*

B.A., Western Maryland College

M.S., Towson University

**Dr. Lena K. Garrison**

*Assistant Professor, Biology; Discipline*

*Coordinator, Life Sciences*

B.A., Duke University

M.A., University Wisconsin-Madison

Ph.D., Northern Illinois University

**Dr. Raza Khan**

*Associate Professor, Chemistry; Chair  
Sciences*

B.S., Howard University

Ph.D., Howard University

**Mr. David P. Reynolds**

*Assistant Professor, Biology*

A.A.S., SUNY, Farmingdale

B.S., LIU at Southampton College

M.S., Drexel University

**Dr. Stacy K. Zell** *Assistant*

*Professor, Biology*

B.S., University of Maryland, College Park

M.A., Virginia Polytechnic Institute

Ph.D., Virginia Polytechnic Institute and State  
University

**ADJUNCT FACULTY**

**Ms. Melanie Dunn**

*Lecturer, Biology*

A.A., Fullerton College

B.S., University of California

M.S., The Johns Hopkins University

**Dr. Jennifer Fain-Thornton**

*Lecturer, Biology*

B.S., Alabama A&M University

M.S., Ohio State University

Ph.D., Ohio State University

**Dr. Joseph B. Harris**

*Lecturer, Chemistry*

B.S., University of Maryland

M.Ed., Towson University

J.D., University of Baltimore

**Dr. Sheila Kinty**

*Lecturer, Biology*

B.S., West Virginia University

M.P.H., University of North Carolina

D.V.M., University of Georgia

**Dr. Gregory S. Leppert**

*Lecturer, Biology*

B.S., Catholic University of America

Ph.D., Catholic University of America

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**Ms. Courtney B. Levin**

*Lecturer, Biology*

B.S., Salisbury University

M.A.T., Salisbury University

**Dr. Sharon Ringgold-Harmon**

*Lecturer, Biology*

B.S., High Point University

Ed.S., Walden University

D.P.M., New York College of Podiatric

Medicine

**Dr. Judy Staveley**

*Lecturer, Biology*

A.A., San Antonio College

B.S., University of Alaska

M.F.S., University of Florida

M.S., St. Joseph College

Ph.D., Walden University

**Dr. Mark Young**

*Lecturer, Chemistry*

B.A., Western Maryland College

Ph.D., Texas A&M University

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**Appendix B: General Education Assessment Tables for non-Science Courses**

<b>Discipline: Emerging Issues</b>						
<b>General Education Learning Goals</b>	<b>DVLY-115</b>	<b>FN-100</b>	<b>HLTH-101</b>	<b>HLTH-201</b>	<b>PHED-101</b>	
<b>1. Communication (Written and Oral)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.	W, O	W, O				
<b>2. Critical Thinking</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.	X	X	X	X	X	
<b>3. Quantitative and Scientific Reasoning</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.		X				
<b>4. Information &amp; Technology Literacy</b> Students will research, create, and communicate information through appropriate technology.	X	X				
<b>5. Creativity</b> Students will explore and appreciate the creative processes that shape the human experience.						
<b>6. Global Awareness</b> Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment.	X					
<b>8. Personal Development and Social Responsibility</b> Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.	X	X	X	X	X	



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**General Education Learning Goals Assessment Plan**

**Academic Division: ENGLISH**

**General Education Learning Goals**

	ENGL-101	ENGL-102	ENGL-103	ENGL-110	ENGL-160	ENGL-201	ENGL-202	ENGL-205	ENGL-209	ENGL-220-221	ENGL-240	ENGL-245
<b>1. Communication (Written and Oral)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.	√	√	√	√	√	√	√	√	√	√	√	√
<b>2. Critical Thinking</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.	√	√	√	√	√	√	√	√	√	√	√	√
<b>3. Quantitative and Scientific Reasoning</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.										√		
<b>4. Information &amp; Technology Literacy</b> Students will research, create, and communicate information through appropriate technology	√	√	√	√	√	√	√	√	√		√	
<b>5. Creativity</b> Students will explore and appreciate the creative processes that shape the human experience.		√	√	√						√		
<b>6. Global Awareness</b> Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment.	√	√	√		√	√	√	√			√	
<b>9. Personal Development and Social Responsibility</b> Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.	√	√	√	√		√	√	√		√	√	√

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**General Education Learning Goals Assessment Plan**

**Discipline: Fine & Performing Arts**

**General Education Learning Goals**

	ART-125	ART-135	FPA-101	FPA-105	MUSIC-101	MUSIC-102	MUSIC-103	MUSIC-105	THTR-101	THTR-137	SPCH-101
<b>1. Communication (Written and Oral) (PG2)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.	W	W	W	W	W	W	W	W	W	W	W
<b>2. Critical Thinking (PG3)</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.											
<b>3. Quantitative and Scientific Reasoning (PG1)</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.								X		X	
<b>4. Information &amp; Technology Literacy (PG4)</b> Students will research, create, and communicate information through appropriate technology.	X	X	X	X	X	X	X		X	X	X
<b>5. Creativity</b> Students will explore and appreciate the creative processes that shape the human experience.	X	X	X	X	X	X	X	X	X	X	X
<b>6. Global Awareness</b> Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment	X	X	X	X	X	X	X	X	X	X	X
<b>7. Personal Development and Social Responsibility</b> Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.	X	X	X		X	X	X	X	X	X	X

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**General Education Learning Goals Assessment Plan**

**Discipline: HUMANITIES**

**General Education Learning Goals**

	ENGL-201	ENGL-202	ENGL-211	HIST-101	HIST-102	HIST-105	HIST-106	HIST-130	PHIL-101	PHIL-105	PHIL-120
<b>1. Communication (Written and Oral)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.				W	W	W	W	W	W	W	W
<b>2. Critical Thinking</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.				X	X	X	X	X	X	X	X
<b>3. Quantitative and Scientific Reasoning</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.											
<b>4. Information &amp; Technology Literacy</b> Students will research, create, and communicate information through appropriate technology.				X	X	X	X	X			

**General Education Learning Goals Assessment Plan**

**Discipline: MATH**

**General Education Learning Goals**

	MATH-111	MATH-115	MATH-120	MATH-128	MATH-129	MATH-130	MATH-135	MATH-136	MATH-205	MATH-210	MATH-215
<b>1. Communication (Written and Oral) (PG2)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.	W	W	W	W	W	W	W	W	W	W	W
<b>2. Critical Thinking (PG3)</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.	X	X	X	X	X	X	X	X	X	X	X
<b>3. Quantitative and Scientific Reasoning (PG1)</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.	X	X	X	X	X	X	X	X	X	X	X
<b>4. Information &amp; Technology Literacy (PG4)</b> Students will research, create, and communicate information through appropriate technology.	X	X	X	X	X	X	X	X	X	X	X
<b>5. Creativity</b> Students will explore and appreciate the creative processes that shape the human experience.											
<b>6. Global Awareness</b> Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment.											
<b>8. Personal Development and Social Responsibility</b> Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.											

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**General Education Learning Goals Assessment Plan**

Discipline: Social Sciences

**General Education Learning Goals**

	ANTH-101	ANTH-201	CRIM-101	ECON-102	GEOG-105	POLS-101	PSYC-101	SOC-101	SOC-110
<b>1. Communication (Written and Oral)</b> Students will communicate effectively in writing and in speech, and interpret the written and oral expressions of others.	W	W	W	W	W	W	W	W	W
<b>2. Critical Thinking</b> Students will practice analytical and evaluative thinking with a view toward continuous improvement.	Y	Y	Y	Y	Y	Y	Y	Y	Y
<b>3. Quantitative and Scientific Reasoning</b> Students will apply mathematical and scientific concepts and theories to identify and analyze problem-solving situation.	Y	N	Y	Y	Y	Y	Y	Y	N
<b>4. Information &amp; Technology Literacy</b> Students will research, create, and communicate information through appropriate technology.	Y	Y	N	N	Y	Y	Y	Y	Y
<b>5. Creativity</b> Students will explore and appreciate the creative processes that shape the human experience.	Y	N	Y	N	N	N	N	N	N
<b>6. Global Awareness</b> Students will acknowledge and comprehend the beliefs, behaviors, and values of diverse populations within a global environment.	Y	Y	Y	Y	Y	N	N	Y	Y
<b>9. Personal Development and Social Responsibility</b> Students will recognize and engage in personal and social behaviors responsible for the wellness of self and community.	Y	Y	Y	Y	Y	N	N	Y	Y

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**Appendix C: Yearly Breakdown of Specific Expenditures**

<b>Equipment</b>					
Item	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
UV Transilluminator	\$ 550.00				
Thermal Cycler		\$ 2,500.00			
Microcentrifuge	\$ 1,400.00				
0.5-10 mL pipette	\$ 540.00				
Replacement Pipettes				\$ 540.00	
<b>Equipment Total</b>	<b>\$ 2,490.00</b>	<b>\$ 2,500.00</b>	<b>\$ -</b>	<b>\$ 540.00</b>	<b>\$ -</b>
<b>Lab Kits</b>					
Carolina- Chromosome simulation-10 station	\$ 195.00		\$ 195.00		\$ 195.00
Carolina-Mendelian genetics kit	\$ 165.00		\$ 165.00		\$ 165.00
Carolina-Human chrom. Analysis adv. Kit	\$ 70.00	\$ 70.00	\$ 70.00	\$ 70.00	\$ 70.00
Carolina-Sordaria genetics kit	\$ 126.00	\$ 126.00	\$ 126.00	\$ 126.00	\$ 126.00
Edvotek- <i>E.coli</i> transform. Bl/Gr fluorescent	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00
Edvotek-SNP analysis PTC gene w/ PCR	\$ 210.00	\$ 210.00	\$ 210.00	\$ 210.00	\$ 210.00
Edvotek-RT-PCR HIV replication	\$ 210.00	\$ 210.00	\$ 210.00	\$ 210.00	\$ 210.00
Edvotek-Sequencing human genome	\$ 80.00		\$ 80.00		\$ 80.00
Edvotek-DNA bioinformatics	\$ 100.00		\$ 100.00		\$ 100.00
<b>Lab Kits Total</b>	<b>\$ 1,261.00</b>	<b>\$ 721.00</b>	<b>\$ 1,261.00</b>	<b>\$ 721.00</b>	<b>\$ 1,261.00</b>
<b>Expendables</b>					
Gel Red	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00	\$ 105.00
0.5-10 mL pipette tips	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00
10-100 mL pipette tips	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00

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100-1000 mcl pipette tips	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00
microcentrifuge tubes	\$ 25.00	\$ 25.00	\$ 25.00	\$ 25.00	\$ 25.00
stock plate w/ fungus	\$ 15.00	\$ 15.00	\$ 15.00	\$ 15.00	\$ 15.00
<b>Expendables Total</b>	<b>\$ 205.00</b>	<b>\$ 205.00</b>	<b>\$ 205.00</b>	<b>\$ 205.00</b>	<b>\$ 205.00</b>
<b>Yearly Total</b>	<b>\$ 3,956.00</b>	<b>\$ 3,426.00</b>	<b>\$ 1,466.00</b>	<b>\$ 1,466.00</b>	<b>\$ 1,466.00</b>

**Appendix D: Specific Example of Annual Report**

**Carroll Community College**

**Learning Outcomes Assessment**

**PROGRAM GOALS and ASSESSMENT REPORT**

**Academic Division:** SCIENCES

**Academic Program:** Sciences

**Courses:** BIOL 210—Anatomy & Physiology 1; BIOL 211—Anatomy & Physiology 2

**Program Goal:** *Goal: 1 Students will find, use, and assess scientific information to demonstrate scientific literacy.*

**Date of Submission:** 10/29/15

Course	Intended Outcomes	Method of Measurement	Benchmark	Final Results	Corresponding Gen Ed Learning Goal
BIOL 210	<ul style="list-style-type: none"> <li>• Student selects and accesses relevant scholarly sources</li> <li>• Student effectively evaluates multiple and diverse sources</li> <li>• Student demonstrates an understanding of what constitutes plagiarism</li> <li>• Student correctly uses APA format</li> </ul>	Rubric scores on a Case History project	70% of the class at Satisfactory level or better	Reported as % at Proficient/Satisfactory/and Developing levels; % at Benchmark <ul style="list-style-type: none"> <li>• 32, 58, 10; 90</li> <li>• 20, 41, 39; 59</li> <li>• 12, 40, 48; 52</li> <li>• 20, 46, 34; 64</li> </ul> N= 31	GE 4



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BIOL 211	<ul style="list-style-type: none"> <li>• Student selects and accesses relevant scholarly sources</li> <li>• Student effectively evaluates multiple and diverse sources</li> <li>• Student demonstrates an understanding of what constitutes plagiarism</li> <li>• Student correctly uses APA format</li> </ul>	Rubric scores on a case history project	80% of the class at Satisfactory level or better	Reported as % at Proficient/Satisfactory/and Developing levels <ul style="list-style-type: none"> <li>• 37, 52, 11; 87</li> <li>• 20, 42, 38; 62</li> <li>• 11, 39, 50; 48</li> <li>• 20, 42, 38; 63</li> </ul> N= 54	GE 4
-------------	--	---	--	---	------

**Strategies for Use of Results:**

**1) Changes to the Learning Process**

- Add more Library instruction on evaluating sources, using APA format, avoiding plagiarism
- Add 1-2 skill building, lower point value, practice assignments prior to the case histories

**2) If changes were made to the learning process, please list the timeline for reassessing the outcome**

- Implement changes to Spring 2016 curriculum
- Reassess Program Goal 1 in the Fall of 2016

**3) Changes to Assessment Process: Examples- change in method of measurement, adjusting the outcomes, setting a different benchmark.**

Note: Not all sections of 210 and 211 used the same assessment process so only those sections with a common assessment method were included here (2 sections of BIOL 210 and 3 sections of BIOL 211). For the Fall 2016 assessment all sections will use the same assessment rubric (attached)

**4) Final Results**

BIOL 210 students above the benchmark only for the first outcome--accessing appropriate sources. They are just below the benchmark for the fourth outcome—using APA format, and they are well below the benchmark for the remaining two outcomes--evaluating sources and avoiding plagiarism.

The benchmark for BIOL 211 is above that of BIOL 210 since the course is the second in a sequence and skills are expected to be reinforced and built upon such that degree of mastery is improved. However, the data between the two courses is not significantly different, indicating that BIOL 211 students are not improving above the skill set acquired in BIOL 210.

These results suggests the need for more Library instruction followed by 1-2 small practice assignments prior to the case history in BIOL 210. For BIOL 211 a better set of reinforcing skill set assignments are also needed prior to the case history.

**Appendix E: Example of 5-Year Program Review (AY 2008-2012)**

**CARROLLCOMMUNITY COLLEGE**

**SCIENCE DEPARTMENT PROGRAM REVIEW**

**DECEMBER 2012**

I. Executive Summary

The Science Department at Carroll Community College is a dynamic multidisciplinary program that provides students with current scientific knowledge and skills for employment and further education, through varied modern instructional techniques, in a challenging, yet convenient and affordable course of baccalaureate-level study. The department offers coursework in biology, chemistry, environmental science, forensic science, the geosciences, physical Science, and Physics, in both traditional and online formats, supporting the college's numerous degree and certificate programs.

As in past years, the major strength of the Science Department continues to be its faculty. Composed of nine full-time, highly effective, veteran teachers with significant experience and expertise in their respective fields, the faculty continually strives to increase student learning and success through regular assessment and enhancement of their teaching practices and departmental procedures.

Enrollments in the Science Department have risen by 57% in the last five years, creating both challenges and opportunities. To accommodate this growth, numerous curricular changes have been implemented, ranging from the addition of course sections, to the creation of new courses and the development of new online offerings. New laboratory facilities were opened in the K building as a function of these increases, as well. While this growth is openly welcomed, it has, unfortunately, placed the Science Department in the situation of being understaffed, with its faculty and classroom, laboratory, and office space fragmented across four campus buildings. As a result, the faculty has formulated several key recommendations to bring these, and other, resource needs in line with the current size and potential future growth of the science program, including a new full-time faculty position and increased administrative release time.

Of great concern to the faculty is the maintenance of high quality teaching and the continued improvement in student achievement. To this end, considerable effort has been put into the development of a well-structured student learning outcomes-based assessment program. Overall, an analysis of student learning outcomes as measured by program goal assessments, course grade success, and withdrawal rates, indicates that the Science Department is quite effective in providing a challenging, achievable, high quality, college-level course of instruction in all of its disciplines. Further, the department's efforts at self-assessment have established a baseline for continued development and improvement of its course offerings and instruction, and have identified specific, pointed areas for instructional and departmental growth and enhancement.

II. Overview

A. Mission, Goals, and Objectives

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Through engaging lab, field, and classroom activities, the Science Department at Carroll Community College seeks to provide students with the current scientific knowledge and skills necessary to prepare them for their educational and career goals.

The major goal of all courses in the biological and physical sciences is to involve the student actively in the use and understanding of the scientific method, using a variety of instructional modes such as technology, analysis and interpretation of data, oral and written communication, information literacy, problem solving, and critical thinking skills.

The Department of Sciences seeks to meet the college's goals of providing convenient and affordable baccalaureate preparation; of encouraging students to be full and active partners in their learning; of creating an environment supporting student and organizational learning; and assessing learning outcomes for the improvement of learning and instruction.

**Science Department Program Goals**

Goal 1 – Students will apply scientific concepts to problem solving situations.

Goal 2 – Students will communicate information in a scientific format.

Goal 3 – Students will manipulate scientific data mathematically.

Goal 4 – Students will demonstrate knowledge of specific course content.

**B. Curriculum**

In support of the college's numerous degree and certificate programs, the Science Department offers baccalaureate-level coursework in biology, chemistry, environmental science, forensic science, the geosciences, physical science, and physics. An overview of these course offerings is listed below. Complete descriptions of all science courses may be viewed on the college website.

**Biology**

BIOL-100: General Biology	BIOL-210: Human Anatomy and Physiology 1
BIOL-101: Fundamentals of Biology 1	BIOL-211: Human Anatomy and Physiology 2
BIOL-102: Fundamentals of Biology 2	BIOL-215: Microbiology
BIOL-105: Human Biology	BIOL-220: Nutrition

**Chemistry**

CHEM-101: Introductory Chemistry	CHEM-201: Organic Chemistry 1
CHEM-105: Principles of General Chemistry 1	CHEM-202: Organic Chemistry 2
CHEM-106: Principles of General Chemistry 2	CHEM-260: Elective Undergraduate Research Practicum

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CHEM-261: Elective Undergraduate Research  
Lab

Environmental Science

ENV-100: Environmental Science

Forensic Science

FCSI-210: Introduction to Forensic Science

Geoscience

GEOC-100: Earth and Space Science

GEOC-201: Meteorology

GEOC-105: Introduction to Oceanography

GEOC-210: Astronomy, Introduction to the  
Cosmos

GEOC-110: Physical Geography

Physical Science

PHSC-100: General Physical Science

Physics

PHYS-101: Fundamentals of Physics 1

PHYS-212: Physics 2 for Scientists and Engineers

PHYS-102: Fundamentals of Physics 2

PHYS-213: Physics 3 for Scientists and Engineers

PHYS-111: Physics 1 for Scientists and Engineers

To accommodate the college's growth of degree and transfer programs that require significant coursework in the sciences, the Science Department has made numerous alterations to existing courses, and has introduced new areas of study. During the past five years, these updates and additions have occurred most notably in the areas of Chemistry and Physics, to support study in Forensic Science and Engineering, as well as to fulfill the increasing demand in the general education tracks. Curricular changes made in the 2007 to 2011 academic years are listed in Table 1.

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**Table 1 - Summary of Science Department's Curriculum Changes (2007 – 2011)**

AC#	Description	Date	President Action
11-01	Create CHEM-260-65 course	Approved 09/09/11	Approved 09/15/11
11-02	Create CHEM-261-65 course	Approved 09/09/11	Approved 09/15/11
11-22	Create a Special Topics Course in Chemistry for Engineering Students transferring to UMCP	Approved 12/09/11	Approved 06/05/12
10-07	Replace 4 credit ENV-105 with 3 credit ENV-100.	Approved 12/10/10	Approved 12/17/10
10-14	Credit courses to carry the Diversity/World View Logo in the College Catalog	Approved 01/14/11	Approved 03/18/11
	Moved department GEOG from SCI to SS per Department Chair's request	4/04/11	
09-47	Add PHYS-111, Physics 1 for Scientists and Engineers as a GE course in the area of Biological and Physical Sciences.	Approved 12/11/09	Approved 02/01/10
09-48	Add PHYS-212, Physics 2 for Scientists and Engineers and design as a GE course in the area of Biological and Physical Sciences.	Approved 12/11/09	Approved 02/01/10
09-49	Add PHYS-213, Physics 3 for Scientists and Engineers	Approved 12/11/09	Approved 02/01/10
09-61	Science Syllabi realignment	12/11/09	02/01/10
09-67	Modify CHEM-201 course	Approved 02/19/10	Approved 03/16/10
09-68	Modify CHEM-202 course	Approved 02/19/10	Approved 03/16/10
09-77	Change to CRIM-210 to FCSI-210, Introduction to Forensic Science and move from a Social Science course to a General Education Science course (3 credits)	Approved 04/09/10	
09-82	Change CHEM-106 to a General Education Science course	Approved 05/14/10	
09-83	Designate PHYS-102, Fundamentals of Physics 2, as a General Education Science course.	Approved 05/14/10	
08-66	Amend the course description of Biology 105, Human Biology	Approved 06/12/09	Approved 07/16/09
07-40	To change the mathematics prerequisite requirement for CHEM-112 Principles of General Chemistry 2, from completion of MATH-120 higher with a "C" grade or better, to completion with a "C" grade better in MATH-128, or consent of the department chair.	AC passed 12/14/07	Approved 2/29/08

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In support of the college's commitment to promoting diversity, in 2011 a three-credit requirement of a Diversity/World View designated course was instituted for all associate degree-seeking students. At present, one science course, ENV-100: Environmental Science, meets this requirement. It is the intent of the Science Department to explore the possibility of additional science courses as candidates for this diversity designation.

Opening in the fall semester of 2012, the Mt. Airy College Center for Health Care Education is a partnership between Carroll, Frederick, and Howard Community Colleges, that provides affordable health care programs in one convenient location. Prior to the opening, the Science Department chairperson and lab manager were involved in collaborating with Frederick and Howard Community Colleges on curriculum and course decisions, facility planning, lab equipment procurement, and the hiring of lab staff. Significant time was spent above and beyond the customary responsibilities of the department chair and lab manager in supporting this initiative.

Moving forward, the department will continue to be involved in staffing biology courses, coordinating lab curriculum for those classes, and collaborating with the other community colleges. The opening of the center means that the department now not only has labs in four separate sites on the main campus, but now manages a remote site as well.

In 2011, a five-year project to develop a program of Learning via Undergraduate Research Experience (LURE) at the college was initiated, with two members of the Science Department faculty serving key roles on the steering team. The desired outcomes of this program are multifold, ultimately fulfilling numerous college mission-related goals, while providing enhanced learning opportunities to students by embedding research practices within existing courses across all general education disciplines. Two such experiences are currently under development in chemistry and biology offerings, as the completion of one research experience is slated to become a graduation requirement of all degree-seeking students, within the project's five-year timeframe.

Significant additional curricular work within the Science Department was conducted in the past five years in the form of ongoing, in-house development of laboratory manuals for many science course offerings. These materials promote consistency and coherency between the lecture and laboratory portions of courses, across all given sections, providing students with valuable resources at a reasonable cost. The development of these manuals, while desirable and valued, constitutes considerable uncompensated (release time, stipend, etc.) faculty effort.

### C. Student Demographics/Enrollment

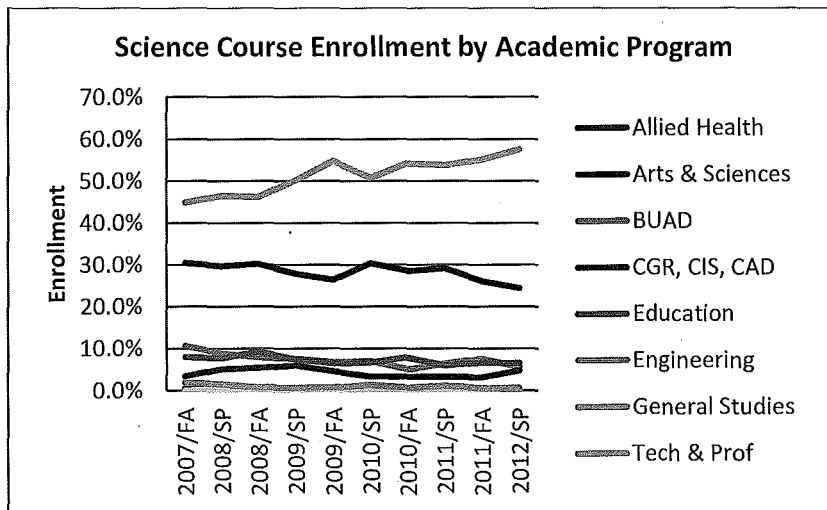
The demographic characteristics of students enrolled in science courses has remained fairly steady during the past five years, largely matching trends seen college-wide. Female to male enrollments have been consistent at 66% and 34%, respectively, with little variation across semesters. On average, 93% of students are Caucasian, with Asian, Hispanic, and African American ethnicities comprising 1 to 3% each, in a given term, with no discernable trends across semesters. Approximately 74% of students enrolled each semester belong to the 18 or 19 year old and 20 to 24 year old age groups, with the overall figure fairly evenly split between the two groups throughout the five-year period. Most of the remaining

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enrolled students fall between the ages of 25 to 49, with only minor variations between semesters in the 25 to 29 year old, 30 to 39 year old, and 40 to 49 year old age groupings.

Of note, however, are the trends of students enrolled in science courses compared to their chosen academic programs. As may be seen in Figure 1, enrollments in most programs remained steady throughout the five-year period, with the greatest abundance of enrollments identified as students belonging to the General Studies and Arts & Sciences fields. Significant growth in enrollments for the General Studies field occurred during the period under review, and is coincident with increases in students completing science coursework in anticipation of beginning study in the Nursing and Allied Health programs. This significant rise in enrollments in the General Studies field, along with continued high enrollments in the Arts & Sciences programs, strongly suggests the Science Department's viability in supporting a college-wide trend toward student selection of completer programs at the college, and those that transfer to four-year institutions (Table 2). The timing of the onset of this trend, after the Fall of 2008, is consistent with local, regional, and national economic and employment factors.

**Figure 1 – Science Course Enrollment by Academic Program**



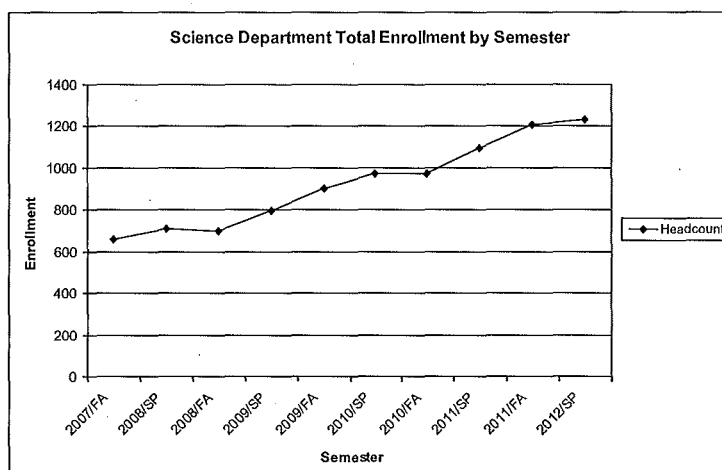
**Table 2 – Enrollment in Programs Supported by Science Courses**

Program	SP2007	SP2012
Nursing	192	412
PTA	72	78
EMS	0	49
HIT	0	144
ENGR	0	13

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The overall enrollment of students in science classes has seen considerable growth during the past five years. This trend has been consistent throughout this time period (Figure 2), and has resulted in an overall growth in credit hour enrollment and the corresponding billable credits of 55% (Table 3). These data suggest that the Science Department is not only supporting the general college educational mission, but is contributing significantly to its overall revenue. By comparison, the total number of credit student enrollments in the Science Department has risen by 57% during the last five-years, while there has been a 7% increase across all other college areas during this same time frame.

**Figure 2 – Science Department Total Enrollment by Semester**



**Table 3 – Science Department Enrollments from 2007 to 2012**

	Spring 2007	Spring 2012	%change
<b>Billing Credit</b>	165	255	55%
<b># Students</b>	785	1233	57%
<b>FTE</b>	103.1	159.7	55%
<b>Credit hr enrollment</b>	3091	4792	55%

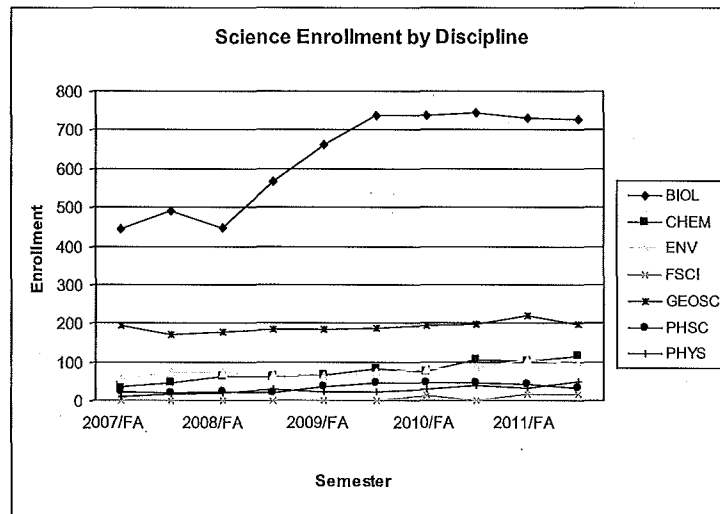


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In 2008, the college began using a waitlist feature in WebAdvisor to manage course enrollments. The waitlist provided a systematic and equitable means of enrollment for students once courses were filled. The tool also allowed for more accurate assessment of course needs such that additional sections have been added when waitlists have risen. At present, the course offerings appear to be aligned with student demand. Most science courses are running full or nearly full with small to no waitlists.

This overall growth in science course enrollments has occurred across all science disciplines within the Science Department, as well. Figure 3 depicts steady growth across all disciplines, most notably by volume of students in biology. The resultant increases in billable credit hours shown in Table 4, however, is more illuminating in terms of program growth and needed resource allocations. Increases in enrollments in biology, chemistry, and environmental science most likely reflect college-wide increases in students opting for degree transfer programs, while those in the Geosciences and Physical Science stem from increases in the Teacher Education programs. At a credit hour growth of 525%, the Physics program, recently bolstered by the advent of an Engineering degree at the college, clearly warrants additional resources and faculty to insure its continued success.

Figure 3 – Science Enrollment by Discipline



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**Table 4 – Credit Hours of Enrollment by Discipline from 2007 to 2012**

Discipline	Spring 2007	Spring 2012	% increase
<b>Biology</b>	1797.0	2879.0	60%
<b>Chemistry</b>	192.0	457.0	138%
<b>Environmental Science</b>	184.0	279.0	52%
<b>Geoscience</b>	644.0	792.0	23%
<b>Physical Science</b>	100.0	140.0	40%
<b>Physics</b>	32.0	200.0	525%
<b>Forensic Science</b>	n/a	45.0	

## II. Assessment of Program Quality

### A. Faculty

All full-time faculty teaching in the Science Department possess earned master's or doctoral degrees in their respective fields, and are veteran post-secondary science educators. These faculty members participate extensively in college activities and have been instrumental on a number of college-wide initiatives. They routinely serve on a variety of college committees and organizational bodies, ranging from the Senate and Academic Council, to Academic Communities and interdepartmental search committees. On campus, many science faculty serve as leaders and mentors for various student organizations, and volunteer their time in campus and community events. Off-campus, members of the Science Department contribute to the local community through numerous presentations, collaborations, and partnerships, involving both the local public school system and the community at large.

The Science Department faculty maintains a strong presence in their respective professional and academic fields, as well, attending and presenting at numerous local, state, and national conferences, workshops, and symposia. A detailed summary of the faculty's professional development, activities, collaborations, and accomplishments is included in Appendix A of this document.

Consistent high quality science teaching is a major goal of the Science Department. Student/faculty evaluations over the five year review period are shown in Table 5. Semesters in which all courses were assessed using the SIRSII evaluation tool are shaded, while those in which only new instructors, or those seeking promotion, are not.

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Over the five year period, scores across all areas were consistently high, with communication and faculty/student interaction being the strongest. This finding is consistent with the department's focus on promoting student learning and quality instruction through improved hiring practices, new faculty mentoring, and continued faculty development.

A list of Science Department faculty and their credentials, as of the last term of this review period are as follows:

**Full-time Science Department Faculty**

**Anne Davis**

B.S., Virginia Polytechnic Institute

Professor, Biology

M.S., Cornell University

**Table 5. SIRSII student evaluation aggregated across all faculty in the science department.**

Category	SP2007+	F2007*	SP2008	F2008	SP2009	F2009	F2010	SP2011	F2011	SP2012
No courses=	14	34	17	34	20	17	52	22	58	17
Course Organization and Planning	4.04	4.36	4.28	4.36	4.26	3.91	4.08	4.32	4.32	4.05
Communication	4.14	4.44	4.36	4.41	4.34	4.06	4.35	4.34	4.41	4.14
Faculty/Student Interaction	4.07	4.43	4.38	4.44	4.45	4.14	4.43	4.40	4.41	4.35
Assignments, Exams, Grading	3.85	4.19	4.14	4.22	4.08	3.89	4.08	4.16	4.18	4.08
Course Outcomes	3.51	3.82	3.55	3.81	3.69	3.45	3.71	3.76	3.77	3.58
Student Effort and Involvement	3.76	4.03	3.93	4.09	3.95	3.96	4.07	4.12	4.03	3.98
<b>Average across dimensions</b>	<b>3.90</b>	<b>4.21</b>	<b>4.11</b>	<b>4.22</b>	<b>4.13</b>	<b>3.90</b>	<b>4.12</b>	<b>4.18</b>	<b>4.19</b>	<b>4.03</b>
<b>Overall evaluation</b>	<b>3.71</b>	<b>4.09</b>	<b>3.91</b>	<b>3.99</b>	<b>3.88</b>	<b>3.54</b>	<b>3.89</b>	<b>3.93</b>	<b>3.98</b>	<b>3.83</b>

\*Shaded columns represent semesters where all courses were assessed

+Non-shaded columns are terms were only new faculty or faculty in promotion are assessed

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Lead faculty for BIOL-101, 220, FSCI-210

**François P. Derasse**

Associate Professor, Biology and Chemistry

B.A., Western Maryland College

M.S., Towson University

Lead faculty for BIOL-210, 211

**William G. Kelvey**

Associate Professor, Geosciences

A.A., Catonsville Community College

B.S., Texas A & M University

M.S., Texas A & M University

Lead faculty for GESOC-105, 201, ENV-100

**A. Raza Khan**

Assistant Professor, Chemistry

B.S., Howard University

Ph.D., Howard University

Lead faculty for CHEM-101, 105, 106, 201, 202,  
260, 261

**Michael L. O'Neal**

Associate Professor, Geosciences

B.A., California State University Fresno

M.S., Shippensburg University

Ph.D., University of Delaware

Lead faculty for GEOSC-100, 110

**David P. Reynolds**

Assistant Professor, Biology

A.A.S., SUNY, Farmingdale

B.S., LIU at Southampton College

M.S., Drexel University

Lead faculty for BIOL-100, 102

**Jerome Schubert**

Associate Professor, Geosciences

B.S., Carnegie-Mellon University

M.S. The Johns Hopkins University

M.S., Loyola College

Lead faculty for PHSC-100, GEOSC-210

**Vacant Biology Position**

Search in Progress

**Full-time Mathematics Faculty serving as Science Department Adjuncts**

**Chuck Grabowski**

Associate Professor, Physics

B.S.E.E., Penn State University

M.S.E.E., Penn State University

M.B.A., Penn State University

M.S.D.E., Teacher Certification, Towson  
University

**Tom Shields**

Assistant Professor, Physics

B.S., Carnegie Mellon

M.S., University of Chicago

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During the past five years, the Science Department faculty body has remained largely stable, with relatively few staffing changes. A slight increase from eight to nine full-time members occurred as David Reynolds joined the faculty as a new biology position was created, and Dr. Michael O'Neal was hired to replace Carol Rabenhorst as she retired from her Geoscience position.

Though they are beyond the timeframe of this review, a few subsequent staffing changes have occurred in the term immediately following this five-year period that are worth illuminating, as they effect faculty position decisions in the next five years. Craig Swanson retired in 2011 (shown as vacant position in list above), and has been replaced by Dr. Lena Garrison. Long-time adjunct instructor Joyce Davis has joined the faculty as a new faculty position in biology, as well. The overall full-time faculty count remains at nine, however, as Chuck Grabowski and Tom Shields have returned to their full-time positions in the Mathematics Department at the college. While the two new biology positions certainly address the need for quality biology faculty to accommodate the large number of students in these courses set by the needs of the nursing, allied health, and general studies programs, the loss of dedicated adjunct faculty back to the Mathematics Department leaves a glaring gap in the Science Department's ability to teach its physics courses with full-time faculty. This comes at a time when there is an increasing demand for physics courses by students in the newly-formed Engineering programs, as well as from a growing number of students in general studies and arts & sciences transfer programs.

A large cadre of adjunct instructors rounds out the faculty in the Science Department. Numbering 23, these adjuncts are of extreme importance to the success of the department, as they represent 72% of the faculty body. As such, it is very important that all adjunct faculty members be highly qualified in their fields, and be treated as experienced members of the instructional team. To accomplish these requirements, the department chair oversees the hiring of all adjuncts, including observing a teaching sample and checking references. These steps have eliminated many of the problems associated with hiring and retaining part-time instructors and, combined with their assignment to a full-time faculty mentor, have contributed significantly to the success and longevity of adjuncts in the department. Several adjuncts have become full-time faculty over the years, and of the 23 current adjunct instructors, 30% have taught at the college for six or more semesters.

Despite the overall success as a unified instructional team within the Science Department, a comparison between the roles of full- and part-time faculty strongly suggests the need for additional resources in faculty positions and release time. Table 6 clearly shows that while the department has grown significantly in course enrollments over the past five years, with a 56% increase in TLH overall, the number of full-time faculty has not kept pace. During this period, the part-time faculty has grown by 92%, while full-time faculty numbers have risen by only 12.5%. This corresponds to TLH increases of 91% and 21% between these two faculty groups, respectively. Add to these changes the fact that full-time faculty TLH values derived as course overloads have risen by 425%, and it is clear that additional full-time faculty are needed to ensure departmental growth with vested faculty guidance.

In the biology and chemistry disciplines, a number of courses are taught as double sections, with students in two different lab sections combined in a single lecture. This practice allows for one instructor to teach a greater number of students, resulting in a saving to the college in instructional

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costs. These sections typically have 36 to 48 students, depending on the maximum seat capacity of the lecture room and the laboratory seat caps.

Presently there are eighteen sections of biology being taught as nine combined lecture sections, and six of chemistry taught as three lecture sections. If these lectures were not combined, the department would need to staff an additional 36 TLHs each semester, or the equivalent more than two full time faculty members. As such, the combined lectures result in a significant savings to the college.

Each faculty member, however, has the additional workload of twice the number of students than a typical section, without any additional remuneration. Of further concern is the possibility that students may be disadvantaged educationally by being in a section with up to 48 students. It is the intent of the Science Department to begin formal assessment of the efficacy of double sections, versus their single section counterparts, in terms of student learning and success. These assessments may require double sections of courses to be renumbered so that they are easily identifiable in institutional data sets.

As discussed above, the recent departure of Mathematics faculty previously responsible for teaching Physics courses, suggests that new faculty are required in this discipline. Additionally, there has been no increase in Administrative Release time during the past five years, despite a 57% increase in the ratio between release time and overall growth in departmental TLH. Significantly more administrative work is being done now, with no more time allotted to do it than was allowed five years ago. Increasingly, multiple sections of Biology 100, 101, and 210, Chemistry 101, 105, 106, 201, 202, 260, and 261, as well as Environmental Science 100 and Physical Science 100, are being offered each semester. These courses all require a full-time faculty member to serve as the lead faculty for a course, providing guidance and mentorship for all adjunct faculty teaching sections of these courses. This situation warrants an examination of the current management structure in the Science Department and consideration of additional administrative release within the department in order to sustain quality of instruction in light of the demands of managing increased course offerings and adjunct instruction.

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**Table 6 – Comparison of Full-time (FT), Adjunct (PT), and Administrative TLH in Science Department from 2007 to 2012**

	Spring 2007	Spring 2012	%change
<b>FT TLH</b>	101	122	21%
<b>PT TLH</b>	101	193	91%
<b>% FT to % PT TLH ratio</b>	50:50	39:61	
<b>Total TLH</b>	202	315	56%
<b>TLH overload FT</b>	8	42	425%
<b>No. Adjunct faculty</b>	12	23	92%
<b>No. of FT faculty</b>	8	9	12.5%
<b>TLH Admin Release for Sci Depart</b>	6	6	0%
<b>TLH / Admin Release</b>	33	52	57%

Note: for this analysis, FT faculty are considered as only those who are members of the Science Department

**B. Student Learning Outcomes**

During the past five years, the Science Department has made significant advances in establishing a student learning outcomes assessment program. Four departmental program goals based on the college's core general education competencies of critical thinking, written communication, and quantitative and scientific reasoning were developed in the fall of 2007. An implementation plan was designed based on assessing one program goal each of the following years, with a sampling of courses assessed for that goal in that year. The intent was that each course would be assessed minimally once during a five-year period. In addition to developing a departmental assessment plan, each of the science course objectives was reviewed and aligned to either a program goal or a general education goal, or both. The alignments are listed on each course syllabus.

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A summary of assessment results compiled across all courses for each program goal is presented in Table 7. While program goals 1 and 2 were met with reasonable student success at reaching their benchmarks, the results for goals 3 and 4 were of more concern. Overall, however, the realization of implementing the assessment plan, from design to completion, was encouraging, as it served its purpose in illuminating potential difficulties in student learning within science courses.

**Table 7 – Science Department Learning Outcomes Assessment Summary for 2007 to 2012 cycle.**

Program Goal	Number of Different Courses Assessed	Percent of Courses Attaining Benchmark
PG 1: Students will apply scientific concepts to problem solving situations	5	4/5 = 80%
PG 2: Students will communicate information in a scientific format	9	8/9 = 89%
PG 3: Student will manipulate scientific data mathematically	6	2/6 = 33%
PG 4: Students will demonstrate knowledge of specific course content	11	3/11 = 27%

Following the administration of each annual assessment, faculty in the Science Department met to analyze and explain the results, to discuss revisions of the assessment tool, and to suggest ways to improve student learning, as measured by the given assessment. A summary of changes in instructional approach and strategies for continuous improvement, as informed by these assessment outcomes, is given in Appendix B.

While the percentage of students achieving the benchmark for program goal 1 was quite reasonable, it was determined that problem solving is challenging for students. Since this method of inquiry is so prevalent in the sciences, it was suggested that additional time should be spent in coursework, giving students greater opportunities to practice and master problem solving skills. Likewise, the results for program goal 2 achievement were impressive. Students were able to communicate scientifically in a variety of formats, including written, verbal, and visual media. One area of concern identified for improvement is students' ability to create and interpret scientific information in graph and table formats.



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Of greater concern were the results of the assessments for program goals 3 and 4. Focusing on students' ability to manipulate scientific information mathematically, it was acknowledged that while many students struggle with mathematical concepts, the skills assessed in program goal 3 should have been more attainable. One possible reason for the lack of student success across multiple courses is the requirement that basic mathematical manipulation be done without the use of calculators. As such, it was felt that more focused mathematical instruction within science coursework was a reasonable strategy. It was also noted that students fared better on this assessment in courses where the mathematics prerequisite courses were the highest. The low results for program goal 4 were puzzling, in that while this assessment measured students' familiarity with specific course content, most students in the sections assessed completed the course quite successfully. Upon reflection, possible explanations for this contradiction included the fact that instructors chose to assess concepts that were known to be particularly challenging, and that the overall sampling of a few test questions may have been too small to allow for accurate assessment results.

Overall, numerous factors for the varying degrees of success on each assessment were considered and identified, ranging from sampling validity, to student interest and preparation, assessment method and challenge, and level of course preparation. While many of the assessment methods were deemed valid, it is the intent and desire of the Science Department faculty to revise and refine the goals and process of assessing student learning outcomes at the start of the next five-year cycle. The specific results of the Science Department student learning outcomes assessment plan are presented in Appendix C.

Another measure of student success, teaching effectiveness, and overall program quality, is that of grade distributions across disciplines and time. Figure 4 shows the percent of students across all courses in each discipline within the Science Department, who earned a grade of A,B, or C, in a given semester, plotted for each fall semester of the five-year period under review. With the exception of a few semester outliers in Chemistry and Physics courses, the department averaged an 80 to 90% pass rate of A,B, or C grades, consistently throughout the time period. This value is above average compared to other departments on campus. The overall five-year pass rate increases to an average of 85 to 95% for students earning grades of A, B, C, or D, as shown in Figure 5.

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Figure 4 – Science Department Course Success ABC% Trend by Fall Semester and Discipline

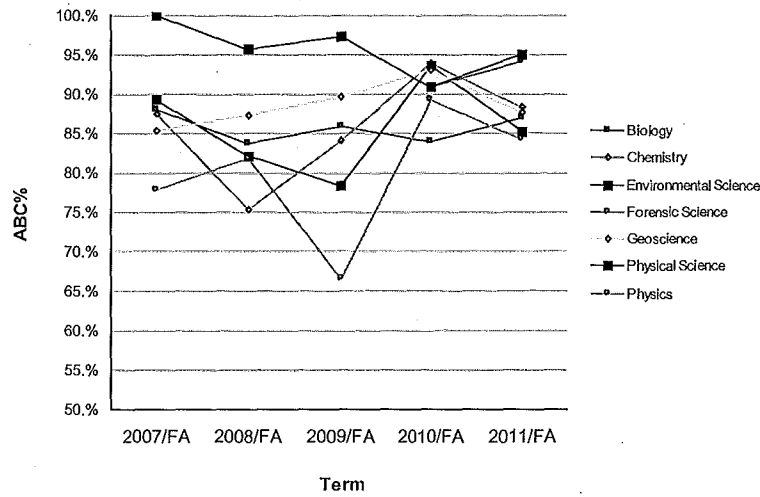
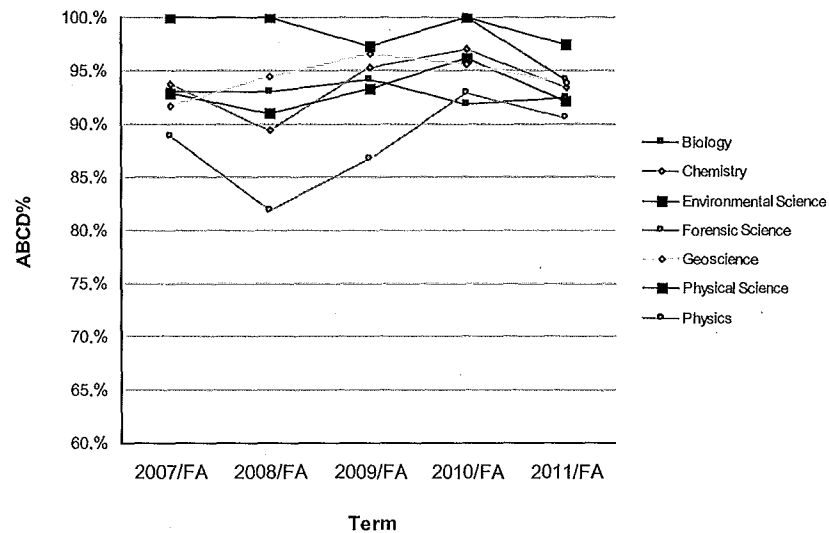


Figure 5 – Science Department Course Success ABCD% Trend by Fall Semester and Discipline



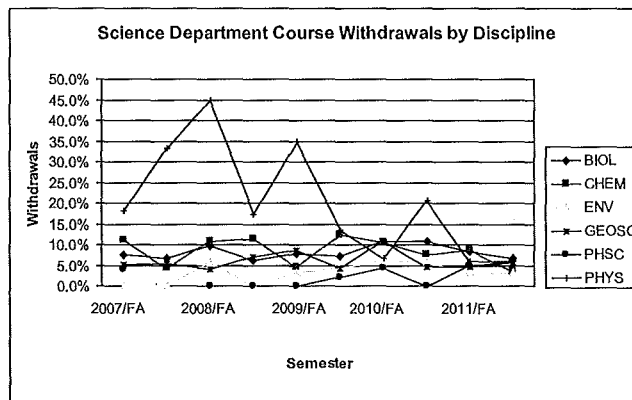
Although more subjective, course withdrawal rates can also be used as a rough indicator of course, discipline, and program success. As shown in Figure 6, course withdrawal rates are fairly low (0 to

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~10%), and generally consistent, across all semesters and disciplines, with the notable exception of Physics courses. A comparison between the Science Department and the rest of the college (Figure 7), however, indicates that over the span of the five-year review period, average withdrawal rates for the sciences are only slightly higher than all other areas of the college combined. If the Physics data were removed from this comparison, there would be no significant difference between the rates for the sciences and the college overall.

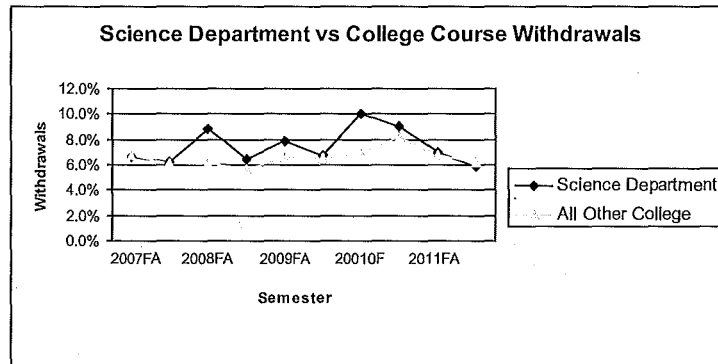
The inconsistent withdrawal trend for Physics courses may be attributed to several factors. Physics courses are generally more mathematically rigorous than most college courses. The low results of the Science Department's assessment of its program goal 3 show students' apprehension for mathematical concepts, so it is not surprising to see higher withdrawal rates in mathematically oriented courses. Withdrawal rates for courses in the Mathematics Department are higher than the college average, as well. In addition, enrollments in Physics courses were lower in the Fall 2007 to Spring 2010 time span than in the remainder of the review period. Even relatively small numbers of withdrawals in a low enrollment course will yield high withdrawal rate percentages. This fact may be seen in a reduction of the withdrawal rates in Physics courses across the Fall 2010 to Spring 2012 period, as enrollments increased due to demand by the Engineering and General Studies programs. Also, while difficult to quantify, the change in the withdrawal trend between the earlier and later segments of the review period may reflect changes in Physics course instructors, as there is a strong correlation between more consistent staffing (Mathematics faculty) and reduced withdrawal rate trends in the later semesters of this time period. In either case, the combination of varying withdrawal rates, increasing enrollments, and the recent loss of consistent staffing by Mathematics Department faculty, strongly suggests the need for a permanent, new faculty position, in Physics, for the Science Department, as previously outlined.

Figure 6 – Science Department Course Withdrawals by Discipline



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**Figure 7 – Science Department vs College Course Withdrawals**



Overall, an analysis of student learning outcomes as measured by program goal assessments, course grade success, and withdrawal rates, indicates that the Science Department is quite effective in providing a challenging, achievable, high quality, college-level course of instruction in all of its disciplines. Further, the department’s efforts at self-assessment have established a baseline for continued development and improvement of its course offerings and instruction, and have identified specific, pointed areas for instructional and departmental growth and enhancement.

**C. Previous Recommendations Addressed**

Numerous recommendations for departmental growth and procedural improvement were made in the 2006 Science Program Review. The department has addressed most of these recommendations in the intervening years, though some were deemed no longer relevant or impractical to implement. Action on the most important recommendations is summarized in Table 8 below.

**Table 8 – Summary of Action Taken on Previous Recommendations**

Recommendation	Action Taken
The new Science Department Coordinator should establish procedures to hire new adjunct faculty and determine their qualifications ahead of time. Checking references and having them do a teaching sample before being hired may help identify potential problems.	The hiring of qualified adjuncts has been ensured by the chair of the Science Department. Prospective hires have to do a teaching sample and have their references checked. This has drastically improved the quality of our adjuncts and reduced problems.

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<p>The Science Department should look at creating courses that could be involved in the new Hills Scholars Program and review current science courses that may have a potential for involvement in service learning.</p>	<p>Science courses are now incorporated in the FIG (First Year Interest Groups) and Hills Scholars Programs.</p>
<p>Science faculty need to have purposeful dialogue to ensure the collection of meaningful learning outcomes assessment data, especially from adjuncts.</p>	<p>In the last decade, the Science Department has made great strides in the collection of learning outcomes assessment data. Adjuncts have been involved in the process.</p>
<p>The Science Department should add online course offerings in BIOL-105 and ENV-105, and look into making GEOSC-105 a biology offering. This would increase science course choices for students intending on obtaining an online AA degree.</p>	<p>Two online courses have been added to the science curriculum: BIOL-100 and ENV-100.</p>
<p>For the next full-time science faculty member, the Science Department needs to seriously consider hiring a biologist with a strong microbiology background. This faculty member would become the lead faculty in BIOL-215.</p>	<p>A full-time microbiology instructor has recently been hired.</p>
<p>Lab manuals that have been written in-house and in use for numerous years should be revised and improved with more visuals, web links to appropriate internet sites, and possibly CDs with additional materials.</p>	<p>In-house lab manuals are now in place for most courses, and are periodically revised and improved.</p>

D. Laboratory Support Services

Laboratory investigations are an integral component of most science courses. As such, the preparation of laboratory exercises, and the acquisition and maintenance of laboratory equipment and supplies by the laboratory support staff is an invaluable asset to the Science Department.

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As the Science Department has grown considerably during the past five years, so has the need for the number of laboratory preparations per week, as course sections and new courses have been added to accommodate this growth in enrollment. Adding to the complexity of maintaining laboratory support is the fact that laboratory facilities are spread across campus, in the A, C, K, and M buildings. As the college continues to grow and realign its' facilities to match its' enrollment and programmatic needs, consideration should be given to consolidating all of the Science Department's classroom, laboratory, and office space into a single campus building. This move would improve laboratory and departmental safety, planning, and preparation across all science disciplines. It is also suggested that an initial improvement in these areas could be made by incorporating laboratory discussion time to regularly scheduled departmental meetings.

In addition to supporting the Science Department, the laboratory support staff have served in, and collaborated with, numerous campus and community programs and endeavors. These activities include supplying and maintaining equipment and services to the Nursing, Physical Therapy Assistant, and Veterinary Technician programs at the college, as well as providing laboratory space and assistance for the community "Kids at Carroll" and "Maryland Stream Symposium" events. Additionally, the laboratory support staff worked diligently to assist in the design, planning, and outfitting of laboratory space, in a hectic deadline schedule, of the newly opened Mt. Airy College Center for Health Care Education. At present, these personnel are:

**Sandy Shaw – Laboratory Manager/Chemical Hygiene Officer**

Hired 11/1984 to oversee laboratory facilities in A building

Active member of the National Association of Scientific Material  
Managers (NAOSMM)

Registered with the American Society of Clinical Pathology

**Edit Luka – Instructional Technician I-Science**

Hired 2/2006 after laboratory facilities opened in C building

**Jennifer Smith – Instructional Technician I-Science**

Hired 1/2010 after laboratory facilities opened in K building

Registered with the American Society of Clinical Pathology

All laboratory staff support departmental needs in the M building.

In an effort to comply with OSHA regulations, Sandy Shaw became the Chemical Hygiene Officer at the College in 2011. At present, a Chemical Hygiene Plan is under development to inform all required laboratory safety guidelines. While safety issues are routinely discussed at departmental meetings, it is suggested that all full- and part-time Science Department faculty complete a required, online, safety training program to adhere to OSHA regulations.

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During the past five years, the number of laboratory sections offered has increased dramatically, as shown in Table 9.

**Table 9 – Science Department Lab Section Offerings 2007 - 2012**

<u>Course</u>	<u>2007</u>	<u>2012</u>
BIOL 100	5	6 + 2 online
BIOL 101	14	25
BIOL 102	1	1
BIOL 105	4	4
BIOL 210	10	16
BIOL 211	9	13
BIOL 215	8	12
CHEM 101	2	7
CHEM 105	4	4
CHEM 106	1	3
CHEM 201	0	1
CHEM 202	0	1
CHEM 261	0	1
ENV 100	6	0 Changed to lecture only.
FSCI 210	0	2
GEOC 105	2	3
GEOC 210	2	2
PHSC 100	2	4
PHYS 101	2	3
PHYS 102	1	1
PHYS 111	0	1
PHYS 112	0	1

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PHYS 212	0	1
PHYS 213	0	1

As laboratory sections have increased, so has the need for coherent laboratory instruction. Within the Science Department, many faculty create their own laboratory manuals in-house. These are reproduced and sold at the bookstore, helping to reduce costs to students, as well as copying expenses for the college. It is suggested that a standardized development format be adopted for all in-house laboratory manuals, to aid not only the laboratory support staff in the planning and preparation of laboratory exercises, but for adjunct faculty as well.

E. Support Services

**Library Support** - Librarians have supported and assisted the science faculty and curriculum in numerous ways over the last five years. Some of the ways in which librarians contributed to the science program at Carroll include:

**Embedded Librarianship** - Embedded librarians assist faculty by establishing a presence on a faculty member's Blackboard page and assisting students at their point of need. Librarians are embedded in 19 science classes in Fall 2012, and have been embedding in classes since Spring 2012. Librarians are currently embedded in the following classes for Fall 2012:

**Table 10 – Librarians Embedded in Science Courses – Fall 2012**

Course Number	Number of Sections Embedded
BIOL 101	6
BIOL 105	1
BIOL 210	2
BIOL 211	2
BIOL 215	2
CHEM 105	2
CHEM 201	1
GEOS 210	1
PHSC 100	2



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**Library Instruction and Instructional Support** - Librarians have taught 53 library instruction sessions for science classes (BIOL, CHEM, GEOS, and ENV) since Fall 2007, providing instruction for 1256 students. Librarians have also made brief visits to individual classrooms to discuss documentation and to introduce resources in an informal manner. Librarians have also consulted with faculty on instructional design and planning for assignments.

**SMART Scholars Support** - In Spring 2012, librarians participated in the SMART scholars program, met individually or in small groups with 16 students to demonstrate specific resources and assisted with APA citation. Librarians have also met individually with CHEM students to advise them on documentation during Spring 2012.

**Subject Research Guides** - Librarians have created and currently support 5 Subject Research Guides relating to the sciences. These include Subject Research Guides for Biology, Chemistry, Geoscience, Environmental Sciences, and one combined guide for Physics, Physical Sciences, and Astronomy.

**Collection Development** - Librarians have worked with faculty to develop the Library's print and electronic science collection. Since 2007, librarians have purchased 993 titles in the sciences, own approximately 3200 volumes, and have circulated 2595 items in that subject area. Librarians have two online databases dedicated to the sciences (ProQuest Biology Journals and McGraw Hill's Access Science) as well as two multidisciplinary (EBSCO's Academic Search Premier and Master File Premier) and a News database (ProQuest Newspapers) that cover science topics for both general and academic audiences. Librarians regularly solicit science faculty for titles and resources to strengthen the collection. The science collection is continually updated and evaluated based on circulation of titles and currency of materials. New acquisition lists are shared with science faculty on a monthly basis.

**Reference Assistance** - Librarians provide science students with in-person, phone-based, and electronic assistance at the reference desk, help them find and evaluate resources for research projects, and document those sources. Librarians often provide individual instruction in using resources during reference transactions.

**Academic Center** - The Science Department has worked with the Academic Center to promote tutoring for biology, chemistry, physics, and anatomy and physiology students. Several different models for meeting times and locations were implemented (with limited success). Workshop strategies towards improving learning, note taking and test taking in science have been developed by the Academic Center and conducted over several semesters. An overview of appointment-based tutoring activity in the sciences is shown in Table 11.

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**Table 11 – Overview of Appointment-Based Science Tutoring**

Appointment tutoring				
# of tutors	SP 2011	FA 2011	SP 2012	FA 2012
Biology	7	8	11	8
Chemistry	3	5	5	6
Physics	3	3	2	2
A&P	2	3	3	3
Others				
<b>Total</b>	<b>15</b>	<b>19</b>	<b>21</b>	<b>19</b>

Data represents number of students attending weekly tutoring appointments.

Table 11 Continued.

Appointment tutoring											
# of Students	FA 2007	SP 2008	FA 2008	SP 2009	FA 2009	SP 2010	FA 2010	SP 2011	FA 2011	SP 2012	FA 2012
For Biology	5	10	11	11	27	10	18	25	25	22	32
For Chemistry	0	1	13	9	10	6	7	7	6	6	17
For Physics	1	4	2	4	2	0	3	3	5	3	5
For A&P	1	0	0	0	0	14	7	1	1	1	10
Others											
<b>Total</b>	<b>7</b>	<b>15</b>	<b>26</b>	<b>24</b>	<b>39</b>	<b>30</b>	<b>35</b>	<b>36</b>	<b>37</b>	<b>32</b>	<b>64</b>

\*\*\*There were numerous science drop-in students, particularly in the FA of 2012.

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A successful collaboration between the Science Department, Distance Learning, and Academic Services, resulted in the creation of the online peer learning experience called "Chemistry Community." In this model, students use Blackboard to post questions to peer tutors, reducing the anxiety of approaching an instructor. Chemistry faculty monitor posts and replies for accuracy, maintaining academic and student/faculty integrity.

**Student Life** - The Science Department currently has three science faculty advisors for the student clubs: STEM Club, The Green Team, and the Game Club.

**Career Development** - The Science Department participated in the "Advice & a Slice" event for three semesters with 100+ students participating. Professionalism, Branding, and Resume workshops were conducted by the Career Development office for Chemistry classes. The Science Department participated in the Opportunities Fair which was conducted every Fall semester from 2007 to present and ranged from 65-100 students participating in each event.

**Advising Office**—"On Target with Science" workshop was developed with the cooperation of the advising office to promote science courses and to inform students of courses transferring to other institutions. The Advising Office also provided advising in alternate environments where advising staff accompanies students on science field trips. They also provide informational handouts for students regarding courses transferring to other institutions.

**Other Departments** - The Science Department collaborates with the Math and English departments in the Health & Wellness FIGH, and met with the Nursing Department to identify needs of the students to be prepared for the Nursing Program.

### III. Recommendations

#### A. Strengths

As has been the case for many years, the greatest strength of the Science Department continues to be its faculty. As individuals, they are all highly effective, veteran teachers with significant experience and expertise in their respective fields. As a group, they genuinely care about student learning and the continued growth and effectiveness of their department and college, and regularly take action to assess and enhance their teaching practices and departmental procedures. They communicate regularly and openly on all aspects of quality science instruction, sharing ideas, innovations, and techniques readily. There is a camaraderie among the Science Department faculty that is obvious to any observer. This situation is not a given in academia, and is valued and nurtured by all involved.

With this body of content knowledge and teaching expertise, the Science Department faculty provides their students with a challenging, academically rigorous, yet supportive and achievable program of baccalaureate-level science instruction, across numerous disciplines. The department routinely posts appropriately high A, B, or C course grade student success rates. Combined with low overall course withdrawal rates, it is clear from these trends that the Science Department contributes significantly to the college's goals of maintaining student retention and promoting degree completion.

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An additional strength of the Science Department lies in its increased enrollments over the past five years. As new programs across the campus have been developed, and more students have turned to community colleges for part of their post-secondary education in difficult economic times, the Science Department has effectively adapted to the requirements of these programs, serving the needs of the college at large.

B. Challenges

An integral part of maintaining a quality program of instruction is the regular, meaningful assessment and modification of teaching practices. During the latest five-year cycle of student learning objective assessment, mixed results were obtained regarding the department's program goals. While these results were not excessively negative, they are cause for reflection. In the next five-year cycle, the implementation and assessment of these goals will be examined and refined to ensure that science teaching effectiveness is maintained across all disciplines. Though listed as a challenge, this procedure is viewed as a natural part of a quality science program.

Increased enrollments are a strength for any program, but do bring the need for additional resources. All disciplines in the Science Department have seen significant growth during the past five years, most notably in biology, chemistry, and physics. Additional sections of courses have been added in each, but only biology has received additional faculty. Of the three, Physics is the only discipline to encounter growth, and the loss of its principal instructors at the same time. The two instructors previously teaching Physics courses have recently returned to full-time positions in the Mathematics Department at the college, leaving the Science Department understaffed, particularly in Physics. For these reasons, it is the desire of the department to acquire a new full-time faculty position, seeking a hire with a strong background in Physics.

The growth of the Science Department has also resulted in an increase of the number of adjunct faculty. While the procedure for hiring adjuncts has been greatly improved, the bulk of the time and effort spent to ensure the procurement of quality part-time faculty falls to the department chair. Following their hire, however, these new faculty are then assigned to a full-time faculty mentor and lead instructor for the courses they will teach. The result is, again, improved instruction, but also increased faculty time spent in the mentoring process. Add to these responsibilities the significant increases in faculty time spent in curriculum and instructional materials development as the number of course offerings and sections have increased, and an imbalance in the workload of full-time faculty members is evident. The amount of release time allocated to the Science Department has not changed in the past five years, despite the significant, additional time and responsibility. For these reasons, the department seeks an increase in its TLH administrative release time allocation.

An additional challenge brought about by increased enrollments and the growth of the Science Department is its physical fragmentation across the college. Having adequate classroom, laboratory, and preparation space is a definite plus for the department, but the location of laboratory space in three different buildings, and classroom and office space in four, presents definite issues of practicality, inefficiency, and safety. It is becoming increasingly difficult to prepare laboratory exercises when materials and equipment must be moved from building to building, using public hallways and elevators.

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In addition to safety concerns, the ability to share equipment between disciplines is becoming time consuming and impractical. Having faculty and laboratory staff located remotely from one another also presents challenges in critical laboratory planning and maintenance. Though presenting challenges of its own, it is the desire of the Science Department to have all of its classroom, laboratory, and office space located in one building on campus.

#### C. Opportunities

In addition to bringing about challenges, increased enrollments also produce opportunities. With growing numbers of students taking science courses as part of their General Education and Arts & Sciences transfer programs, and the coincident removal of the requirement in these tracks to take their two mandatory science courses from different disciplines, it would seem a reasonable time to explore the creation of transfer patterns or programs within the Science Department. Discussion has already begun, and will continue, on the creation of such potential programs in biology, chemistry, environmental science, and pre-med/pre-vet concentrations.

As the college continues to increase its offerings of online courses to broaden its market and create new programs and pathways for degree completion, so should the Science Department. Of interest to the department is the creation of an online version of BIOL-105, Human Biology.

#### D. Recommendations

##### Recommendation from Previous Program Review

1. The Science Department should develop an online version of BIOL-105, Human Biology

##### New Recommendations

1. The Science Department should examine, refine, and revise its Mission, Goals, and Objectives statements to bring them in line with departmental and college-wide changes over the past five years.
2. The Science Department should examine, refine, and revise its Student Learning Outcomes assessments and assessment procedures in implementing its Program Goals, as part of its new five-year plan.
3. The Science Department should acquire a new full-time faculty position, and consider a hire with a strong background in Physics.
4. The Science Department should examine its current management structure and consider how additional administrative release time could be allocated to ensure the sustainability of quality of instruction and student learning support in response to enrollment increases over the last five years.
5. The Science Department should explore the feasibility of, and develop programs and/or transfer patterns for, all of its disciplines and concentrations.

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6. The Science Department should have all its classroom, laboratory, and office space located in one building to improve laboratory and departmental safety, planning, and preparation.
7. The Science Department should explore its current offerings to identify additional courses (beyond ENV 100) that meet, or could be adjusted to meet the college's Diversity/World View requirement.
8. The Science Department should initiate the formal assessment of the efficacy of double sections versus single sections of courses, in terms of student learning and success.
9. The Science Department should request that double sections of courses be numbered in such a fashion that they may be easily recognized in institutional data.
10. The Science Department should consider a standardized format in subsequent revisions of its in-house laboratory manuals to more readily facilitate laboratory preparation. A "revision copy" of all laboratory manuals should be kept in each laboratory, for laboratory staff to note potential changes while in immediate laboratory preparation. These potential changes should be discussed with faculty when laboratory manuals are revised.
11. The Science Department should consider adding regular laboratory discussion time to department meeting agendas, and ensure that laboratory staff are included in subject discipline meetings to create a unified planning approach.
12. The Science Department should require an online safety course for all full- and part-time departmental personnel to ensure adherence to OSHA standards.

### References

- Biological Aide*. (2016). Retrieved from Career planner's website:  
<http://dot-job-descriptions.careerplanner.com/BIOLOGICAL-AIDE.cfm>
- Career outlook* (2016). Retrieved from the Bureau of Labor Statistics Website:  
<http://www.bls.gov/careeroutlook/2001/spring/art01.pdf>
- Community colleges giving students a framework for STEM careers*. (2016). Retrieved from the Oxford Journals' website: <https://bioscience.oxfordjournals.org/content/62/7/632.full>
- Economic modeling* (2016) [www.economicmodeling.com](http://www.economicmodeling.com)
- Healthcare occupations*. (2016). Retrieved from the Bureau of Labor Statistics Website:  
<http://www.bls.gov/ooh/healthcare/home.htm>
- Industry data*. (2015). Retrieved from the Department of Labor, Licensing & Regulation website: <https://www.dllr.state.md.us/lmi/iandoproj/wiasindustry.shtml>
- Maryland biohealth story*. (2016). Retrieved from the Maryland Department of Commerce website:  
<https://open.commerce.maryland.gov/biohealth-technology>
- Occupational outlook handbook*. (2016). Retrieved from the Bureau of Labor Statistics Website:  
<http://www.bls.gov/ooh/life-physical-and-social-science/home.htm>
- USAJobs*. (n.d.). Retrieved June 22, 2016, from USAJobs website: <https://www.usajobs.gov/Search/?keyword=student+trainee&Location=&AutoCompleteSelected=&search=Search>
- Workforce regional occupational projections – Maryland occupational projections 2012 – 2022 workforce information and performance*. (2015). Retrieved from the Department of Labor, Licensing & Regulation website: <https://www.dllr.state.md.us/lmi/iandoproj/wias.shtml>
- What is the job outlook for the future*. (n.d.). Retrieved June 22, 2016, from AIBS website:  
<https://www.aibs.org/careers/#outlook>

