

COMMUNITY COLLEGE OF PHILADELPHIA

Proposal for

ASSOCIATE OF SCIENCE IN BIOLOGY

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Date:

February 7, 2014

Recommended Effective Semester:

Fall 2014

I. Abstract

The Department of Biology at Community College of Philadelphia is proposing a new program that will confer an Associate of Science degree in Biology upon students who wish to transfer into a baccalaureate program in biology or into a biology-related pre-professional program. The curriculum is designed to provide students with the requisite intellectual and practical skills necessary to successfully transfer to four-year institutions.

The Pennsylvania Transfer and Articulation Oversight Committee (TAOC) does not recognize the existing interdisciplinary program of Associate of Science in Science for transfer and articulation purposes. TAOC only recognizes discipline specific degrees which align with offerings at the Pennsylvania State System of Higher Education (PASSHE). The new program will conform to State requirements and delineate the coursework required by area four-year colleges while still allowing some flexibility for specialization within the field of biology.

II. Opportunities and Problems Addressed by the Proposed Program

Currently at Community College of Philadelphia, there is a need for clearer, more targeted pathways for students wishing to pursue a degree in biology at a four-year institution, to enter biology-related pre-professional programs such as pre-veterinary, pre-medical, or pre-dental, or to transfer directly into professional programs such as a doctoral program in Pharmacy (PharmD). The Culture, Science, and Technology program primarily serves students pursuing a career in nursing or other allied health professions. Also, the existing Associate of Science is a poor match with current standardized program-to-program articulation agreements in biology, as outlined by the Pennsylvania Department of Education's Transfer and Articulation Oversight Committee (TAOC). TAOC's April 11, 2012 document states that the statewide agreement "ensures that a student who successfully completes an Associate of Arts (A.A.) or Associate of Science (A.S.) degree in Biology or any A.A. or A.S. degree that incorporates the required competencies at a participating institution can transfer the full degree into a parallel bachelor degree program in Biology at a participating four-year institution." Excerpts from the 2012 Biology TAOC document can be found in Appendix A.

A survey of 632 students enrolled in at least one of the courses in the proposed curriculum (Biology 123, 124, 211, 241, Chemistry 121, 122, 221 or 222) showed that there was a strong interest in the curriculum. Of the 142 respondents nearly 63% were within their first two years of college, the targeted group for this Program. Nearly 90% were students of the College (not guest students). Nearly 19% of the respondents plan to pursue a four-year biology degree, 13.6% plan to pursue science education, and greater than 17% of the respondents plan on pursuing a pre-professional program such as medicine or pharmacy. Temple, Drexel, Thomas Jefferson and LaSalle were all identified as the top institutions at which the respondents plan to pursue these studies. Finally, respondents showed strong interest in the courses listed in the proposed curriculum: 64 students expressed interest in taking Immunology; 63 students expressed interest in Biochemistry; and 30 students expressed an interest in Research Methods. Moreover, in the last two years the College has conferred degrees upon 109 students in the A.S. in Science curriculum, a population that would contain potential A.S. in Biology candidates. Taken

collectively, these data (Appendix B) suggest a need for the development of an A.S. in Biology, existing alongside a more generalized A.S. in Science.

In 2012 the President's Council of Advisors on Science and Technology (PCAST) announced an initiative to produce an additional one million college graduates with degrees in Science, Technology, Engineering and Mathematics (STEM) fields over the next ten years. However, according to PCAST's *Engage to Excel* report, one of the main hurdles to this lofty goal is the fact that 60% of STEM majors switch to non-STEM majors within the first two years. The creation of an intermediate goal, the A.S., might help to staunch this loss. Additionally, the persistence of traditionally-underrepresented groups hovers near 20%. As a college that predominantly serves underrepresented groups, Community College of Philadelphia must take this opportunity to help bridge this gap.

PCAST further states that attrition for both minority and non-minority students is highest in the first two years of a student's academic career. Therefore structuring the A.S. in Biology as a focused curriculum coupled with specific advising, existing systems of support, and programs that engage the student in hands-on laboratory activities at an early stage can work to reduce attrition among students interested in a STEM program and career. It would also provide students interested in the biology-related pre-professional programs listed above with the necessary foundations for success. After graduating from the College with an A.S. in Biology, students will have completed the requirements of the first two years of a four-year degree and would begin taking junior-level courses upon arrival at their transfer institution.

The Associate of Science in Biology program is designed to mirror the courses taken in the first two years at the institutions to which our students most frequently transfer. Moreover, it is comparable in scope and rigor to degree programs at other regional Associate-granting colleges in Pennsylvania, such as Bucks County Community College, Community College of Allegheny County, and Harrisburg Area Community College. Requirements for these programs can be found in Appendix C.

Although the program proposed within this document outlines a general A.S. in Biology, flexibility exists for exposure to sub-disciplines within biology.

III. Expected Program Participants

The proposed program, with its intended flexibility, would serve two main populations. First, it would serve those students who intend to transfer to a four-year university to pursue a baccalaureate degree in the many biology-related disciplines (e. g., environmental science, molecular biology, biochemistry) or pre-professional programs previously mentioned. Students in this proposed program would be trained in the fundamentals of biology specifically and science generally by completing a series of introductory courses in biology, chemistry and mathematics. The second year would allow more flexibility for students to tailor their coursework to their area of interest by selecting from a number of 200-level biology electives

that are consistent with TAOC-specified competencies. Throughout the core courses of the new curriculum, student learning will focus on the development of rational thought, critical analyses, and logical application of the current theories of biology.

IV. Description of Proposed Program

A. Student Learning Outcomes

These student learning outcomes were distilled from two sources. First, they are aligned with course level outcomes for existing Biology courses. Second, they incorporate the goals of the institutions to which our students most frequently transfer.

Upon successful completion of this program, the graduate will be able to:

- Summarize the major physical and chemical concepts and processes essential to living things, including the maintenance of homeostasis, the energy transformations occurring within and between organisms and the interactions among living organisms and their environment.
- Describe the mechanisms of reproduction and heredity, from both classical (Mendelian) and molecular perspectives, and link genetic influences to evolutionary processes and adaptation.
- Appropriately use current scientific terminology and evaluate the merit of scientific data using critical thought.
- Explain the levels of organization in biology, including the chemical, cellular, histological, and organismal levels, and explain the dynamics of populations, ecosystems and the biosphere.
- Utilize the Scientific Method for the development of hypotheses, the proper design of experiments, the competent use of equipment, the collection and analysis of data, and the integration of scientific literature.
- Compare and contrast the major groups of microbes, protists, plants, and animals.

B. Meeting the College Mission

The proposed A.S.in Biology program is in keeping with the mission of the College. The study of biology stresses the interdependence of diverse life forms as well as the strength such diversity creates. The new program will emphasize systematic investigation and critical thought as the keystone for understanding the world we inhabit while nurturing curiosity about our world. The proposed program includes instruction in the role of biology in society as well as a critical evaluation of its merit.

Biology-related issues surround the citizens of modern society in everyday life: genetic modification of organisms, stem cell research, and sustainability of the global ecosystem, to name a few. Graduating from the College with an Associate of Science in Biology degree will give students the scientific literacy and competency not only to make informed decisions about these issues, but also to play an active role in how they shape society and the natural world.

The College's mission statement emphasizes the importance of providing a foundation for college transfer and employment. This degree program is specifically designed to provide the smoothest possible experience for students transferring into a baccalaureate program in biology or into one of several biology-related pre-professional programs.

C. Program Transferability

The A.S. in Biology degree has been developed in keeping with the existing state regulation that an associate degree must include a total of at least 60 credits for graduation. Of these 60 credits the Statewide Program-to-Program Articulation Committee for Biology mandates successful completion of between 14 and 17 credits of biology-related coursework, four Chemistry courses (with laboratories), and at least 30 credits of general education courses.

The proposed curriculum and supporting documentation has been presented to officials at Temple, Thomas Jefferson, Drexel and LaSalle Universities. These officials were asked to provide feedback on how our proposed curriculum would transfer to their institutions relative to the demands of the TAOC document. As of this writing, there are preliminary communications of a favorable response to the curriculum from Temple University.

D. Enrollment Management

To encourage enrollment into the new curriculum, informational sessions can be offered and advertising will be done during Majors and Transfer Fairs. These efforts will be reinforced by biology instructors at all campuses who will describe the new curriculum to their students and emphasize the possibilities it offers.

Recognizing that a number of students, who may be interested in pursuing a Biology degree, enter the College below the level of MATH 161 biology faculty have developed initiatives to target this population of students. Examples of these initiative include but are not limited to working with ENGL 098 faculty to invite students to study skill workshops targeted to science, providing the opportunity for peer mentoring and providing access to guest lecturers working in the field of science.

To get the most out of the A.S. in Biology program, students should feel engaged in the curriculum. To this end, a range of extracurricular activities will be offered. Funding from the U.S. Department of Education's Predominantly Black Institutions (PBI) and the National Science Foundation's Alliance for Minority Participation (AMP) programs has, in recent years, enabled the Biology department to offer several types of activities aimed at students in currently-existing science curricula. Such activities have included on-campus speaker series (e.g. 150 students in 2011; 89 students in 2013), summer bridge programs (e.g. 20 students in 2013), as well as summer field trips to scientific laboratories in the local area(e.g. 64 students in 2013). From 1995 through 2012, AMP funding has provided science students with opportunities ranging from participation in workshops on academic portfolio construction and science study skills to academic research at local universities and the Smithsonian Institution, Brookhaven

National Laboratories, and Monell Chemical Senses Center. In the future, these and similar experiences will be made available to those students seeking an A.S. in Biology degree. An additional grant, RISE (Raising Interest in Science Education) has recently been awarded to the Biology department. Initiatives of this grant include an increase in the recruitment and retention of STEM students coming from traditionally under-represented groups.

In addition to grant initiatives, faculty-driven recruitment and retention activities are already institutionalized. For example, the Center for Science and Engineering Education (CSEE), since its foundation in 2009, has given students opportunities to participate in extracurricular activities related to the biological sciences. One such activity involves many students in biology courses conducting small, semi-independent research projects and presenting their findings to the College community at the annual Poster Session. While not all participants were potential A.S. in Biology candidates, this activity could be used to foster engagement for students in this new program. In 2013, several students in biology courses volunteered at CCP's booth in the city-wide "Science on the Parkway" event, which was sponsored by the Franklin Institute and part of the Philadelphia Science Festival.

Another CSEE initiative, the College Connection for Science and Engineering Technology (CCSET) invites high school student to come to the College and participate in laboratory experiments. Over the past 5 years approximately 40 high school students per year have participated in this program. Biology faculty have participated in this program and can use this as a vehicle to encourage these students to enroll in the College for the A.S. Degree in Biology.

V. Internal Program Coherence

Student Experience

For students who follow the recommended sequence, the first biology courses students will take are Biology 123 and Biology 124. In these two courses alone, students will be introduced to many of the competencies required for a fully-transferable associate degree in Biology. They will also be exposed to a rigorous laboratory environment with a strong emphasis on experimental design, data analysis, and critical thinking. During their second year, students will take between six and nine credits of two hundred-level Biology courses. Currently, the College offers Biology 241 (Microbiology), 211 (Genetics), and 255 (Biotechnology) to fulfill this requirement. In these courses, students apply, reinforce and practice the competencies and skill sets introduced in Biology 123 and Biology 124, while being given the opportunity to delve into specific sub-disciplines in more detail.

Because all processes in biological systems are chemistry-based, students are required to take four chemistry courses, each involving a laboratory component. A two-semester sequence of organic chemistry (Chemistry 221 and 222), in particular, is essential to any mastery of biology, as most of the critical molecules making up all living things are carbon-based, thus organic.

To work effectively in any biology-related career, one must have a functional knowledge of mathematics. Therefore, Precalculus II and Calculus I (Mathematics 162 and 171, respectively)

are required for the A.S. program. Although Calculus is not required by TAOC, the Biology faculty feels that Calculus I should be required because many four year colleges and universities require calculus for and/or calculus based physics for Biology majors.

Students fulfill their General Education requirements throughout their time in the program by taking such courses as English 101 and 102. Since effective speaking in small groups as well as in public is a critical part of presenting scientific information, students will also take English 115 (Public Speaking) as part of this program. Moreover, biological research is increasingly technologically driven. As such, biology students will be exposed to the possibilities provided by technology in CIS 103.

For
Associate of Science in Biology

The proposed curriculum for an A.S. in Biology satisfies the College mission and the Student Learning Outcomes detailed within this document. Displayed below are the core and existing elective courses of this curriculum matched to the Student Learning Outcomes. Assigned for each pair is the level of competence broken down along a continuum from introduced (I), to practiced and reinforced (R), and finally to mastered (M). Because this is not a terminal degree, and a significant part of the expected student population will continue their education, mastery of all SLOs is not expected. Instead, mastery will be achieved as they complete their coursework at their four-year institution of choice. Where appropriate, evidence of competence will be collected (A - Assessment).

Curriculum Map for A.S. in Biology

	Required Courses				Program Electives		
Student Learning Outcomes	BIOL 123	BIOL 124	CHEM 121, 122	CHEM 221,222	BIOL 211	BIOL 241	BIOL 255
Summarize the major physical and chemical concepts and processes essential to living things including the maintenance of homeostasis, the energy transformations occurring within and between organisms, and the interactions among living organisms and their environment.	I, R, A	R, A	I	R	R, A	R, A	
Describe the mechanisms of reproduction and heredity, from both classical (Mendelian) and molecular perspectives, and link genetic influences to evolutionary processes and adaptation.	I, R, A	R, A			R, M, A	R, A	R
Appropriately use current scientific terminology and evaluate the merit of scientific data using critical thought.	I, R	R, A	I	R	R	R	R, A
Explain the levels of organization in biology, including the chemical, cellular, histological, and organismal levels, and explain the dynamics of populations, ecosystems and the biosphere.	I, R, A	R, A			R, A	R, A	R
Utilize the Scientific Method for the development of hypotheses, the proper design of experiments, the competent use of equipment, the collection and analysis of data, and the integration of scientific literature.	I, R, A	R, A	I	R	R, A	R, A	I, R, M, A
Compare and contrast the major groups of microbes, protists, plants, and animals.	I	R, A			R, A	R, A	R

CATALOG DESCRIPTION

The Associate of Science (A.S.) in Biology degree program is for students who wish to pursue baccalaureate studies in the biological sciences or plan to fulfill prerequisite courses for pharmacy school or for programs such as pre-veterinary, pre-medical, and pre-dental. To enable seamless transfer, this curriculum is designed to parallel the first two years of study offered in biology programs at other colleges and universities.

STUDENT LEARNING OUTCOMES

Upon successful completion of this program, graduates will be able to:

- Summarize the major physical and chemical concepts and processes essential to living things including the maintenance of homeostasis, the energy transformations occurring within and between organisms, and the interactions among living organisms and their environment.
- Describe the mechanisms of reproduction and heredity, from both classical (Mendelian) and molecular perspectives, and link genetic influences to evolutionary processes and adaptation.
- Appropriately use current scientific terminology and evaluate the merit of scientific data using critical thought.
- Explain the levels of organization in biology, including the chemical, cellular, histological, and organismal levels, and explain the dynamics of populations, ecosystems and the biosphere.
- Utilize the Scientific Method for the development of hypotheses, the proper design of experiments, the competent use of equipment, the collection and analysis of data, and the integration of scientific literature.
- Compare and contrast the major groups of microbes, protists, plants, and animals.

PROGRAM ENTRY REQUIREMENTS

Students who enter the program should have completed one year of high school biology, chemistry and physics. In addition, students should have completed one year of geometry and two years of algebra. Additional science and mathematics courses are desirable. Students without sufficient high school science preparation can take appropriate basic college courses, such as BIOL 106 and/or CHEM 110, although these courses cannot count toward the degree. In order to enter this select program, students must be at the ENGL 101 and MATH 162 level placement level.

PROGRAM OF STUDY AND GRADUATION REQUIREMENTS

To qualify for the A.S. degree in Biology, students must successfully complete a minimum of 63 credit hours as prescribed and attain a grade point average of 2.0 ("C" average). Students must pass all biology courses with a grade of "C" or better.

To ensure appropriate course selections, students should consult an academic advisor. Students wishing to transfer this A.S. degree to a particular college or university should, with the help of an advisor, review that institution's requirements and/or existing articulation agreements with the College so that program courses may be chosen appropriately. The recommended course sequence follows.

**Associate of Science in Biology Degree Program
Recommended Course Sequence**

Course Number and Name	Prerequisites/ Corequisites	Credits	Gen Ed Req
<u>FIRST SEMESTER</u>			
CHEM 121— College Chemistry I	CHEM 110 or Department Head approval	4	
CIS 103— Applied Computer Technology		3	Technical Competency
ENGL 101 — English Composition I		3	ENGL 101
MATH 162 – Precalculus II	MATH 161, MATH 162 placement	3	Mathematics
Social Science Elective		3	Social Sciences
<u>SECOND SEMESTER</u>			
BIOL 123— Cellular and Molecular Biology	CHEM 121 or CHEM 110	4	
CHEM 122— College Chemistry II	CHEM 121	4	
ENGL 102 — The Research Paper	ENGL 101	3	ENGL 102, Info Lit
Humanities Elective		3	Humanities
Directed Elective (Choose one)		3	
ANTH 101, ECON 181, ECON 182, HIST 101, HIST 102, HIST 103, HIST 121, HIST 122, POLS 111, PSYC 101, PSYC 201, SOC 101, SOC 231			
<u>THIRD SEMESTER</u>			
BIOL 124 — Organismal Biology	BIOL 123	4	
CHEM 221 — Organic Chemistry I	CHEM 122	4	
MATH 171- Calculus I	MATH 162	4	
Biology Elective		4	
BIOL 211-Genetics or BIOL 241-Principles of Microbiology or BIOL 255 Biotechnology I: Basic Laboratory Techniques in Biotechnology			
<u>FOURTH SEMESTER</u>			

CHEM 222 — Organic Chemistry II	CHEM 221	4
ENGL 115 — Public Speaking	ENGL 101	3
Biology Elective		4
BIOL 211-Genetics or		
BIOL 241-Principles of Microbiology or		
BIOL 255 Biotechnology I: Basic Laboratory		
Techniques in Biotechnology		
Directed Elective (Choose One) ART 105, ART		3
115, ENGL 190, FREN 101, FREN 102, MUS 103,		
PHIL 101, PHIL 211, SPAN 101, SPAN 102,		

MINIMUM CREDITS NEEDED TO GRADUATE **63**

General Education Requirements

All General Education requirements are met through required courses (as indicated above) except for the **Writing Intensive** requirement, the **Interpretive Studies** requirement and the **American/Global Diversity** requirement. Therefore, in order to graduate, students in this program must choose one course that is designated **Writing Intensive**, one course that is designated **Interpretive Studies** and one course that is designated **American/Global Diversity**. The same course may be used to fulfill more than one of these requirements. View the courses that fulfill all [degree requirements](#) and receive a more detailed explanation of the College's general education requirements to help in your selection.

VI. Program Institutional Congruence

As previously mentioned, data show that students who are interested in STEM fields have very low persistence rates compared to non-STEM fields and that attrition is greatest in the first two years of study, especially among underrepresented groups. Thus the College is ideally positioned to address these problems. The creation of an A.S. in Biology would allow for the early identification and support of students interested specifically in biology during these formative educational years. The A.S. in Science program is structured to be adaptable to all scientific fields and as such may be too broad in scope. The A.S. in Biology would foster a close advisory and instructional relationship between students specifically interested in biological sciences and faculty who would help to support these students. Moreover, the creation of cohorts among students bolstered by existing grant structures and common interests would foster a sense of support among the students themselves.

The Biology Department will oversee the curriculum for the A.S. in Biology under the auspices of the Division of Math, Science and Health Careers. It will meet all of the College distribution and General Education requirements.

Program Support Structure

The Learning Laboratories are already dedicated to academic support for students taking biology, chemistry, and mathematics courses. Student and faculty tutors in the Learning Laboratories will be invaluable in providing assistance to students working toward the A.S. in Biology. The Biology Department offers open lab sessions allowing students to review and reinforce material covered in structured laboratory sessions.

The Multimedia Services Department has biology-related material on file. Ancillary materials provided with currently-used textbooks are excellent sources of information for review, reinforcement and enrichment of concepts discussed in class. These materials can be used in class, or on the student's own time. Links to other helpful materials are provided on the Biology Department's webpage.

VII. Proposed Courses

The program as presented here has potential for expansion. Two courses are currently being written, one dealing with biological chemistry and one focusing upon biological research. Also an immunology course is under consideration by the biology faculty. If these courses are approved and made available to students pursuing the A.S. in Biology, more diversity could be offered as they choose courses to fulfill their program-specific content competencies.

VIII. Fiscal Implications

A. Estimated Enrollment

In 2011 and 2012, the College granted more than 100 A.S. in Science degrees. As the A.S. in Science transitions to focus upon the physical sciences, it is reasonable to suspect a portion of current A.S. in Science students would be better served by the new A.S. in Biology.

B. Projected Budget

There will be minimal impact on the College budget as the proposal outlined here uses courses, faculty and space that are either currently in existence or already under development. Budgetary considerations for those courses currently under development are described in their respective documents. The biochemistry course may need specialized equipment which will be detailed in that course proposal and the biology faculty has a track record of grant-writing to meet those needs.

C. Specialized Space Needs

Current space is sufficient for the needs of the program, as it is using existing courses.

Appendix A

Transfer Articulation Oversight Committee document (excerpted)

The full document may be accessed at

http://www.patrac.org/Portals/6/PAFiles/PATRAC_P2P_BIOLOGY_Apr11_2012_rev.pdf

PENNSYLVANIA STATEWIDE PROGRAM-TO-PROGRAM ARTICULATION AGREEMENT IN BIOLOGY

Overview

In accordance with Act 50 of 2009, institutions participating in Pennsylvania's statewide college credit transfer system agree to the following policies governing the transfer of credits from a participating associate-degree granting institution into a participating four-year college or university. This agreement specifically ensures that a student who successfully completes an Associate of Arts (AA) or Associate of Science (AS) degree in Biology or any AA or AS degree that incorporates the required competencies at a participating institution can transfer the full degree into a parallel bachelor degree program in Biology at a participating four-year institution.

In order for students to transfer the full associate degree into a parallel bachelor degree program at a participating four-year institution, all of the following criteria must be met:

- Successful completion of at least 30 credits of foundation courses from the Transfer Credit Framework.
- Successful completion of an associate's degree that includes at least 60 credits **and** all of the required major-specific content area competencies identified in this Agreement.
- Successful completion of four Chemistry courses with laboratories and at least four Biology courses with laboratories.
- The associate's degree must include a minimum of 14 and a maximum of 17 credits of Biology-specific coursework as outlined under Required Major-Specific Content Areas in this Agreement.

See Appendix A: Program-to-Program Articulation Model for Biology.

It is therefore understood that students meeting these requirements will be considered by both the associate degree granting institution and the receiving four-year institution to possess the knowledge, skills and abilities necessary for entry as a junior into a parallel bachelor degree program in Biology.

References to courses in all agreements designate competencies and are not to be construed as making a reference to a specific course at a specific institution. Course titles in the agreements are presented for guidance in advising students as to which coursework they should take even though the course at the student's college may not have the specific title mentioned in the agreement.¹

REQUIRED Major-Specific Content Areas

Under this Agreement, a fully-transferable associate degree in the field of Biology must include competencies from three primary content areas:

1. **Biology - 14 credits minimum (17 credits maximum)**
 - A. **Principles of Biology - 8 credits**
 Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in two courses covering the Principles of Biology. See Appendix B: Competencies for Preparation in the Principles of Biology
 - B. **Program-Specific Content Areas – 6 to 9 credits**
 Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in **at least two, but not more than three**, of the following areas:
 - a. Botany
 - b. Genetics
 - c. Microbiology
 - d. Ecology
 - e. Research Methods

¹ Adopted by TAOC and added to the agreement on April 11, 2012.

Pennsylvania Department of Education
Transfer and Articulation Oversight Committee
Approved by TAOC on June 16, 2011
Amended April 11, 2012

2. Chemistry – 16 credits

A. General Chemistry – 8 credits

Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in two courses of General Chemistry. Students will fulfill this requirement by completing General Chemistry I for science majors and General Chemistry II for science majors within Category 4 of the 30 credit Transfer Credit Framework. See Appendix A: Program to Program Articulation Model for Biology, and Appendix J: Transfer Credit Framework.

B. Organic Chemistry – 8 credits

Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in two courses of Organic Chemistry. See Appendix H: Competencies for Preparation in Organic Chemistry, and Appendix I: Competencies for Preparation in Organic Chemistry Laboratory.

3. Mathematics - 6 to 8 credits

Students must meet competencies in two courses of Mathematics. At least one of the courses must be Pre-calculus or Calculus. Students will fulfill this requirement by taking two math courses within Category 3 of the 30 credit Transfer Credit Framework, provided that at least one of the courses is Pre-calculus or Calculus. See Appendix A: Program to Program Articulation Model for Biology, and Appendix J: Transfer Credit Framework.

Appendix A: Program-to-Program Articulation Model for Biology

Major-Specific Content Areas – REQUIRED	Transfer Criteria
Principles of Biology	Successful completion of courses addressing the required competencies specified in this Agreement for Principles of Biology.
Program-Specific Content Areas <i>Students must meet competencies in two, but not more than three, of the following areas:</i> <ol style="list-style-type: none"> Botany Genetics Microbiology Ecology Research Methods 	Successful completion of at least two, but not more than three, courses addressing the required competencies specified in this Agreement for Botany, Genetics, Microbiology, Ecology, and Research Methods.
Organic Chemistry	Successful completion of courses addressing the required competencies specified in this Agreement for Organic Chemistry.
Transfer Credit Framework*	REQUIRED Framework Courses for Students Transferring under this Agreement
Category 1	1 course to be selected by the student with the assistance of an advisor
Category 2	1 course to be selected by the student with the assistance of an advisor
Category 3	2 courses , at least one course must be <u>Pre-Calculus or Calculus</u> .
Category 4	2 courses: <ul style="list-style-type: none"> <u>General Chemistry I for science majors</u> <u>General Chemistry II for science majors</u>
Category 5	2 courses to be selected by the student with the assistance of an advisor
Category 6	2 courses to be selected by the student with the assistance of an advisor

*See Appendix J: Transfer Credit Framework

Appendix J: Transfer Credit Framework²

Students who successfully complete courses from the approved categories below can have their credits transferred and counted towards graduation at any of the participating PA TRAC colleges and universities. Please be aware that certain majors may have specific requirements prescribed by external agencies. It is the student's responsibility to work with an advisor to select appropriate courses as they relate to the major.

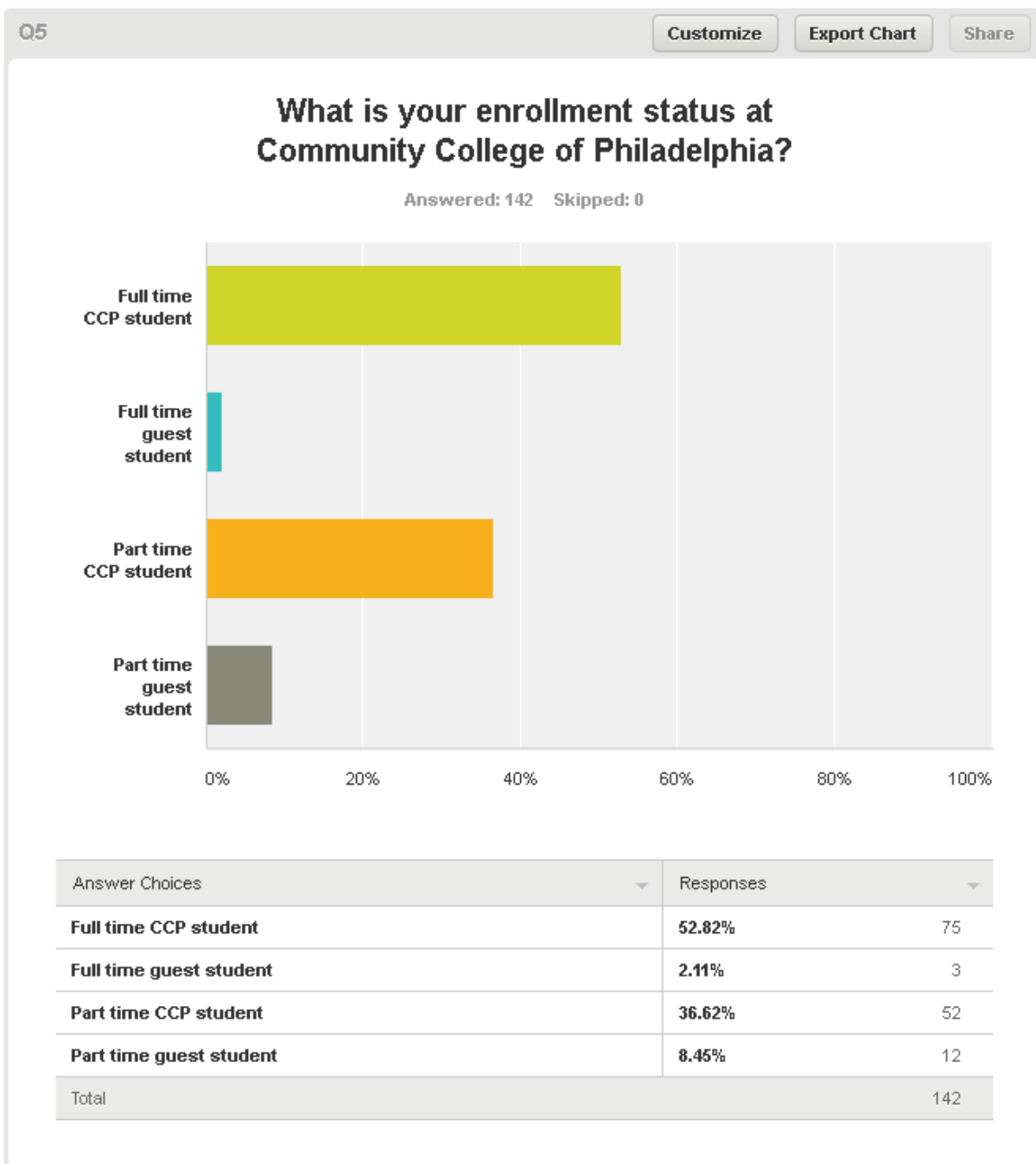
Category 1 (3-4 credits total)	Category 2 (3-4 credits total)	Category 3 (min. 3-4 credits; max. 6-8 credits)	Category 4 Must include lab (min. 3-4 credits; max. 6-8 credits)	Category 5 (min. 3-4 credits; max. 6-8 credits)	Category 6 (min. 3-4 credits; max. 6-8 credits)
English Composition	Public Speaking	Foundations of Mathematics	General Chemistry I (majors & non-majors courses)	General Psychology	Introduction to Music
		College Algebra	General Chemistry II (majors & non-majors courses)	Introduction to Sociology	Introduction to Philosophy
		Elementary Statistics	General Biology I (majors & non-majors courses)	American National Government	Elementary Spanish I
		Precalculus	General Biology II (majors & non-majors courses)	Educational Psychology	Elementary Spanish II
		Calculus I	General Physics I (non-calculus)	History of Western Civilization II	Painting I
			General Physics II (non-calculus)	Principles of Macroeconomics	Elementary French I
			Anatomy & Physiology I*	Principles of Microeconomics	Elementary French II
			Anatomy & Physiology II*	U.S. History I	Drawing I
			Introduction to Astronomy	U.S. History II	Ethics
				History of Western Civilization I	Introduction to Art
				Contemporary Social Problems	German I
				Introduction to Anthropology	German II
				Child Growth & Development	Introduction to Literature (may also be known as Introduction to Poetry, Interpreting Literature, Reading Literature, Theses in Literature, Topics in Literature, Current Themes in Literature)
				Child Psychology	Survey of American Literature
					Literature of the Western World
					World Literature
					American Literature
					Survey of English Literature
					Introduction to Theatre

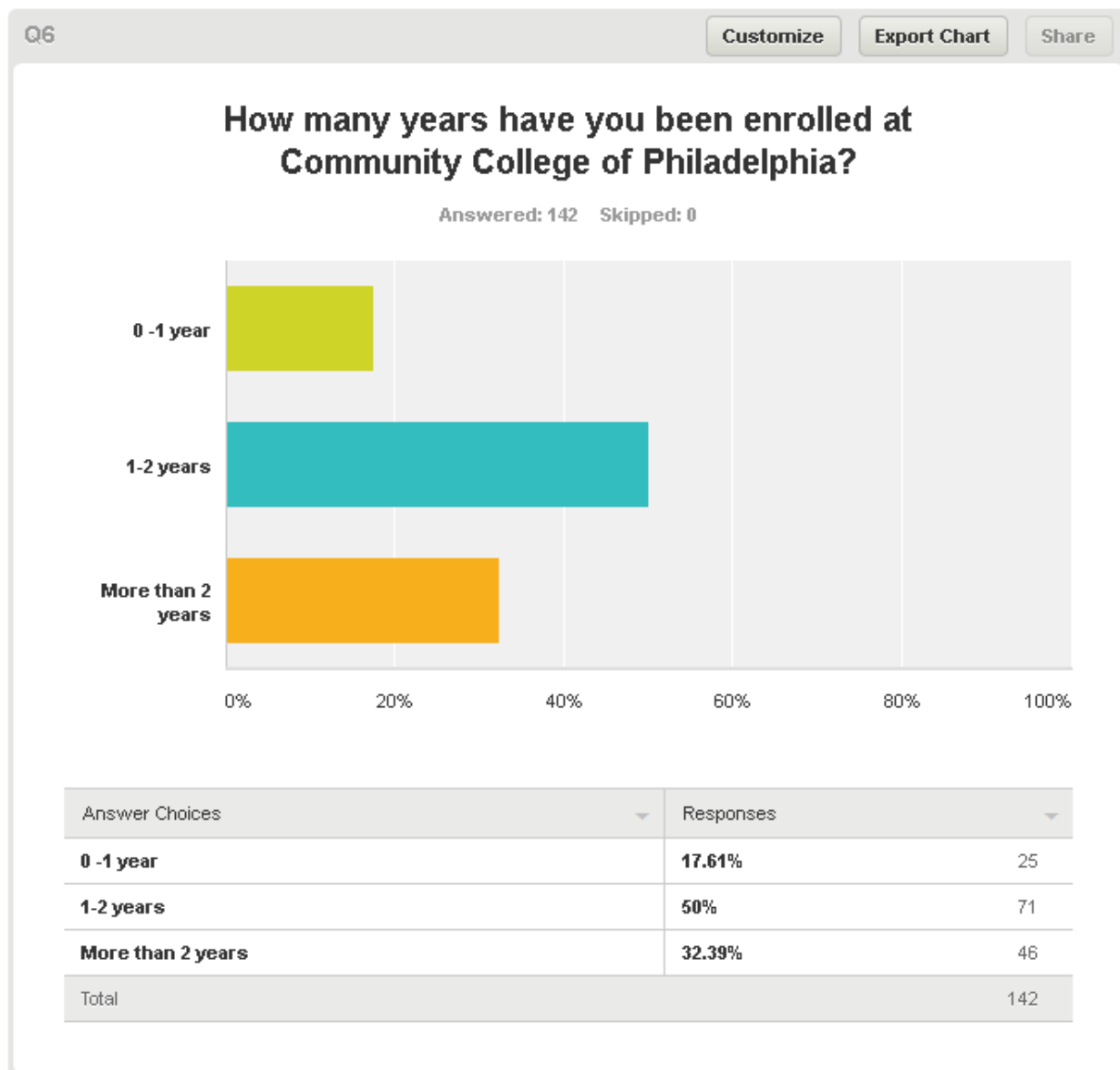
* Biology students are advised that Anatomy & Physiology I & II in Category 4 will not meet the requirements for separate anatomy and physiology courses required in most Bachelor's Degree programs.

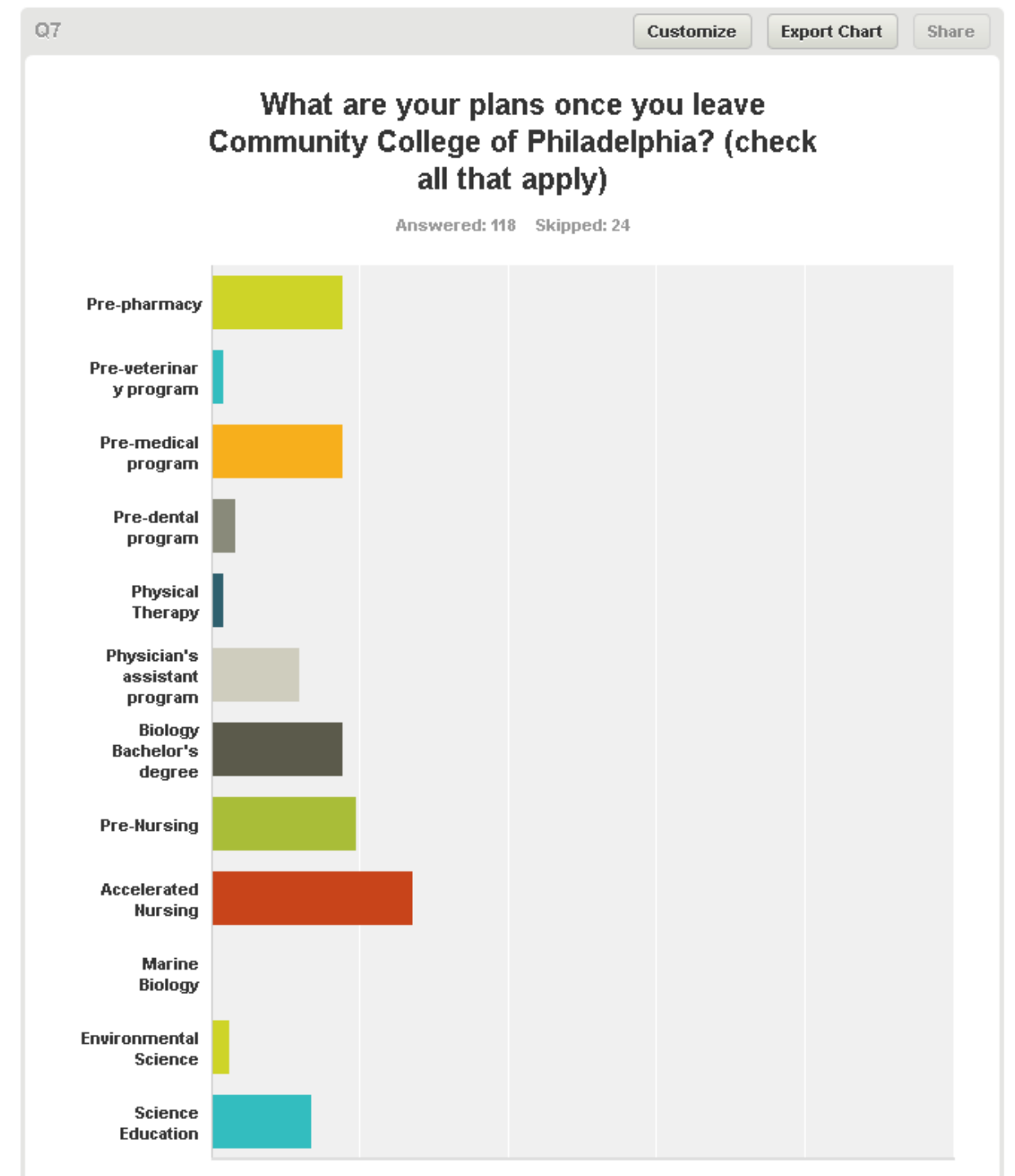
²Framework chart amended on April 11, 2012 to include Child Growth & Development and Child Psychology under Category 5.

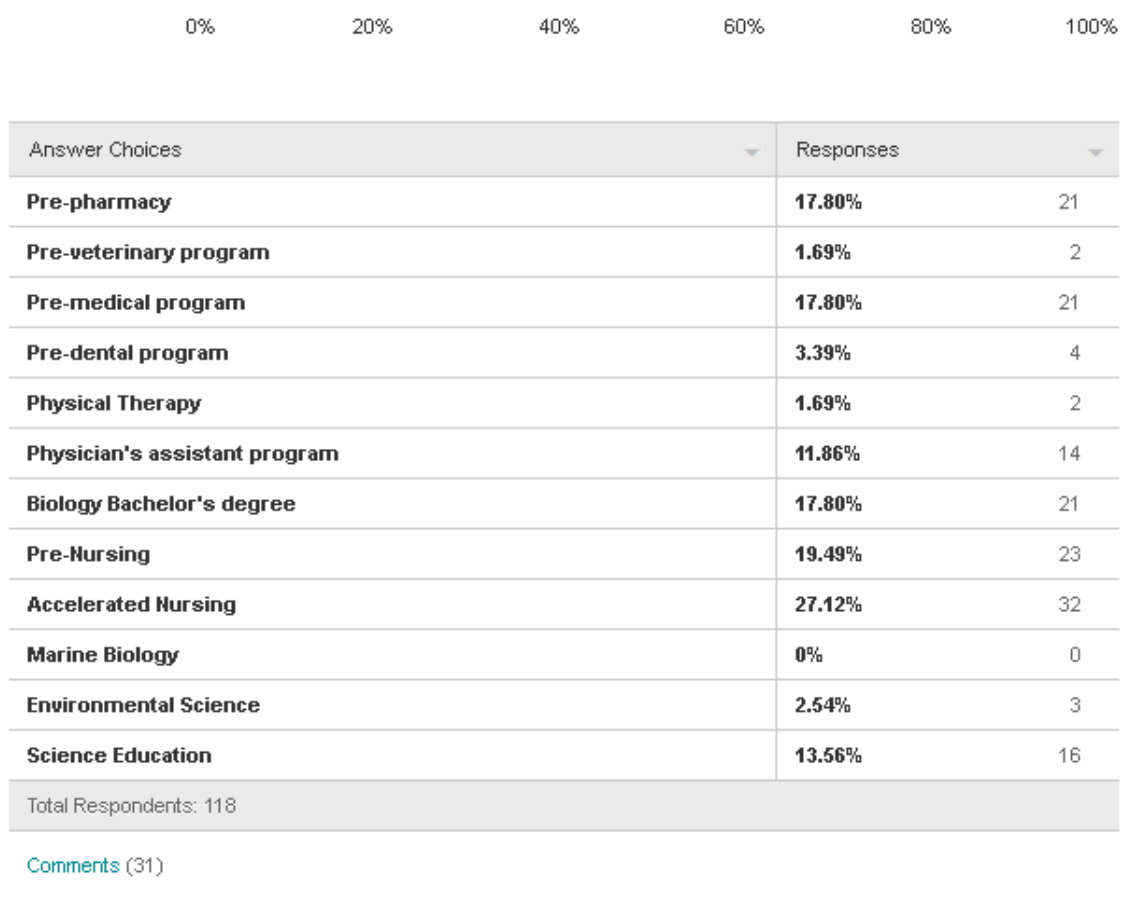
Appendix B

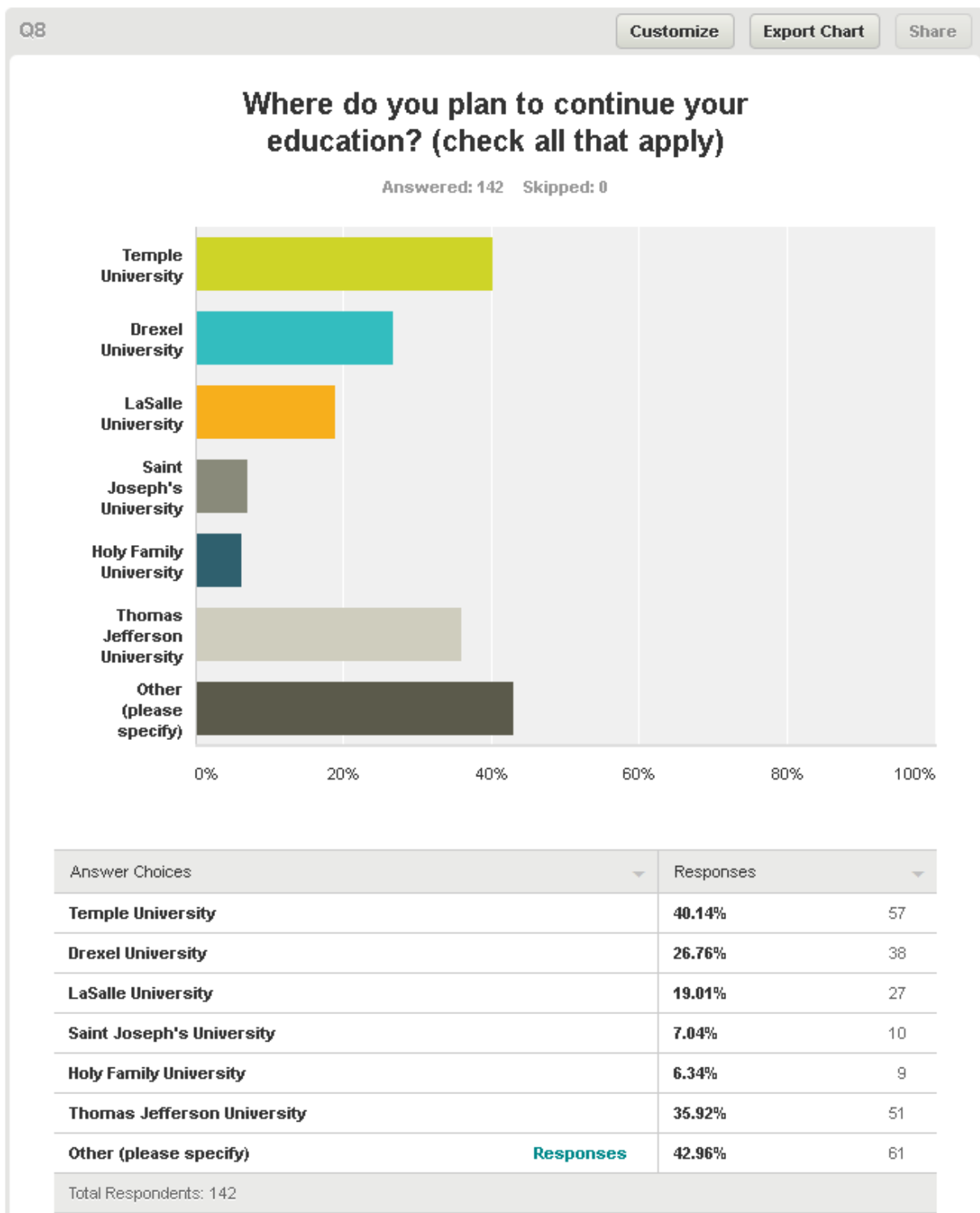
Raw data from prospective biology student survey

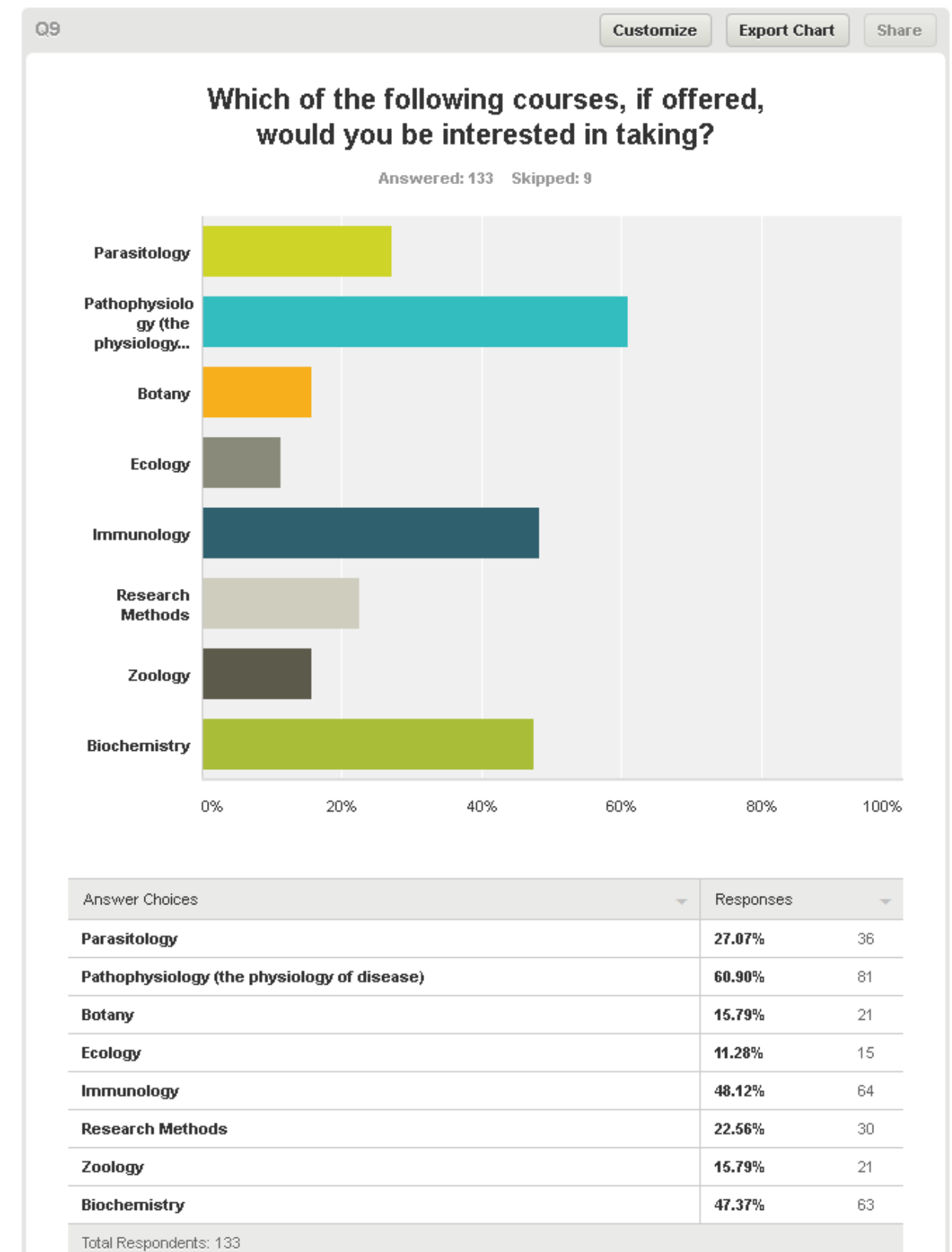












Appendix C

A.S. documents from selected, comparable, regional colleges.

- C.1. Harrisburg Area Community College**
- C.2. Community College of Allegheny County**
- C.3. Bucks County Community College**

C.1. Harrisburg Area Community College

BIOLOGY, Associate in Arts Degree - 3091

Lower division courses in the life sciences are offered as preparation for a student who will transfer to a four-year institution that offers a bachelor's degree program in biology, pre-medicine, pre-veterinary, ecology, marine biology, physical therapy, or teaching. Since the requirements of senior institutions vary widely, it is essential to choose an intended transfer institution as soon as possible and carefully follow the program described in that college's catalog. The complete program is available at the Harrisburg Campus. Some required courses are available at the Lancaster, Lebanon, York, and Gettysburg campuses, and at other sites.

Career Opportunities

This transfer curriculum is provided as a guide for students planning to transfer to a baccalaureate degree granting institution.

PROGRAM REQUIREMENTS (TOTAL CREDITS = 64)

General Education		Major	
ENGL 101 English Composition I	3	BIOL 102 General Biology II	4
ENGL 102 English Composition II	3	CHEM 102 General Inorganic Chemistry & Qualitative Analysis	4
COMM 101 Effective Speaking	3	CHEM 203 Organic Chemistry I	4
Core A Elective	3	CHEM 204 Organic Chemistry II	4
Core B Elective	3	Biology Electives:	8-12
Core B Elective	3	Select two but not more than three from the following courses:	
Core C BIOL 101 General Biology I	4	BIOL 206 or 250, 212, 215, 221	
Core C CHEM 101 Organic Inorganic I	4	Transfer Electives**	3
*Core C MATH 104 Trigonometry	3		27
*Core C MATH 119 Pre-Calculus	4	**Select from the following: BTC 101; CHEM 221; ENVS 201; GEOL 101, 102, 201;	
General Education Transfer Elective	3	MATH 121, 122, 202; PHYS 201, 202	
Physical Education & Wellness	1		
	37		

*May be replaced by a higher level MATH

RECOMMENDED SEQUENCE FOR FULL-TIME STUDENTS

Part-time students can complete this program by taking one or more courses each semester.

Fall Semester		Spring Semester		Fall Semester		Spring Semester	
ENGL 101	3	BIOL 102	4	COMM 101	3	Biology Elective	4
BIOL 101 (Core C)	4	CHEM 102	4	Biology Elective	4	Core B Elective	3
CHEM 101 (Core C)	4	ENGL 102	3	Core A Elective	3	Transfer Elective	3
Math 104 or higher	3	MATH 119 or higher	4	CHEM 203	4	CHEM 204	4
Core B Elective	3	Gen Ed Trans Elec	3	PE & W	1		

Effective Fall 2008 all Associate Degree Programs must meet Diversity (D) and Physical Education and Wellness (W) requirements.

C.2. Community College of Allegheny County

Associate of Science (031.3)

This is a program that prepares students with a broad college background and skills in biology for transfer to a four-year institution.

Upon successful completion of the program, the graduate will:

1. Describe the fundamental principles in the biological sciences.
2. Apply the principles of the scientific method.
3. Communicate effectively using scientific terminology.
4. Recognize contributions of science and scientists to humanity's present and future welfare.
5. Critically analyze the implications and consequences of the field of biology

Graduates may earn a bachelor's degree in biology or a related field.

See also programs in **Chemistry** , **Mathematics & Sciences**, **Pre-Health Professions** and **Physics**.

See the **graduation checklist** for this program in printable PDF form.

Degree Requirements

Minimum Credits to Graduate: 64–68

First Semester

Course #	Course Name	Credits
BIO-151	<u>General Biology 1</u>	4
CHM-151	<u>General Chemistry 1</u>	4
ENG-101	<u>English Composition 1</u>	3
MAT-111	<u>College Algebra</u> ¹	3
	<u>Computer Information Technology Elective</u>	3–4
Total Credits		17–18

Second Semester

BIO-152	<u>General Biology 2</u>	4
CHM-152	<u>General Chemistry 2</u>	4
ENG-102	<u>English Composition 2</u>	3
MAT-142	<u>Pre-Calculus</u> ¹	4
Total Credits		15

CCAC Biology (p.2)

Third Semester

CHM-201	<u>Organic Chemistry 1</u>	4
SPH-101	<u>Oral Communication</u>	3
	Humanities Elective	3
	<u>Restricted Elective</u> ^{2, 3}	3–4
	Social Science Elective	3
Total Credits		16–17

Fourth Semester

CHM-202	<u>Organic Chemistry 2</u>	4
	Humanities Electives	3
	<u>Restricted Elective</u> ^{2, 3}	6–8
	Social Science Elective	3
Total Credits		16–18

¹Required as part of TAOC (Transfer and Articulation Oversight Committee). If you are not intending to transfer to an institution that is participating in the state-wide articulation agreement, students may substitute *MAT-108, Intermediate Algebra* or any higher level mathematics course.

Restricted Electives

²For students transferring to a TAOC participating institution, students are required to choose three (3) restricted Biology electives from among the following:

BIO-121	<u>Principles of Sustainability</u>	3
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BIO-201	<u>Botany</u>	4
BIO-207	<u>Genetics</u>	4
BIO-230	<u>Research Methodology & Quality Assurance</u>	3

³For students who are not intending to transfer to a TAOC participating-institution, students are required to meet with a transfer counselor to select three (3) restricted Biology electives based upon the four-year institution where the bachelor's degree will be earned.

C.3. Bucks County Community College

Transfer Major

Decisions on the transferability of courses are made by the four-year colleges and differ from school to school. Students enrolled in this major should contact the Transfer Services Office early in their academic program to determine which courses will transfer to the college of their choice.

Science, Technology, Engineering & Mathematics Department

Founders 112 • Phone: 968-8305

Curriculum Code No. **1003**

The Biology major provides an understanding of fundamental biological concepts. This major is for students planning to earn a baccalaureate degree in biological science or seeking employment as a technician in areas such as ecology, environmental health and sanitation, pollution control, plant science, or animal science.

Graduates of this program are able to

- Explain the unity of life.
- Describe the evidence to support the principle of descent from a common ancestor.
- Explain the use and distribution of energy in living systems.
- Construct tables and graphs from collected data and interpret these compilations.
- Describe the relationship between inheritance, variation and evolution.

Prospective students with academic deficiencies should be aware that they will need additional time to acquire the necessary academic background. Prerequisites and corequisites for required courses must be followed.

Recommended Semester Sequence

The recommended course sequence is designed for full-time students who average 15 credits hours per semester. Students may need more time to complete major requirements based on placement testing. This additional time will entail some adjustments to the sequence recommended.

First Semester

BIOL121 Biological Principles I ^E

<u>CHEM121</u>	Chemistry I ^{D,E}	4
<u>COMP110</u>	English Composition I ^{A,E,1}	3
<u>MATH122</u>	Trigonometry and Analytical Geometry ^{A,B,E,3}	3

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Second Semester

<u>CHEM122</u>	Chemistry II ^E	4
<u>COMP111</u>	English Composition II ^{E,2}	3
<u>BIOL122</u>	Biological Principles II ^E	4
	Cultural Perspectives ^D	3
	Personal Health ^D	2

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Third Semester

<u>CHEM221</u>	Organic Chemistry I ^E	5
<u>MATH125</u>	Precalculus ^{C,E}	4
<u>BIOL228</u>	Microbiology ^E	4
	Social Perspectives ^D	3

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Fourth Semester

CHEM222 Organic Chemistry II ^E 5

BIOL220 Principles of Ecology ^E 4

COMM110 Effective Speaking ^{5,E} 3

INTG285 Integration of Knowledge ^{E,4} 3

15

^A Placement testing required.

^B MATH140 may be substituted.

^C MATH141 may be substituted.

^D Consult the list of [courses approved for this subcategory](#). Any course may be chosen.

^E Course requires prerequisite.

¹ Satisfies College Writing Level I.

² Satisfies College Writing Level II.

³ Satisfies College level Mathematics or Science.

⁴ Satisfies Writing Intensive requirement.

⁵ Satisfies Creative Expression

Students who do not seek the Associate of Arts Degree may earn the legend, "Major Requirements Satisfied", on their transcripts by successfully completing all the courses listed in the major except COMP110, COMP111, three credits in cultural perspectives, six credits in social perspectives, two credits in personal health, and three credits in integration of knowledge. Credits exceeding the required minimum cannot be used to satisfy required credits in other course requirements.