



## BOARD OF REGENTS

### SUMMARY OF ITEM FOR ACTION, INFORMATION, OR DISCUSSION

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**TOPIC:** University of Maryland, Baltimore County: Bachelor of Arts in Biology Education

**COMMITTEE:** Education Policy and Student Life

**DATE OF COMMITTEE MEETING:** June 3, 2014

**SUMMARY:** The proposed B.A. in Biology Education will allow UMBC to produce outstanding teachers who are highly qualified to teach high school biology in order to help address the continuing need to improve secondary STEM education. This program responds to the need at UMBC to provide a clear pathway for students who wish to teach biology at the secondary school level, and students finishing this sequence will achieve a degree that specifically indicates their area of specialization and training.

Over the last five years (2008 – 2013), the UMBC Department of Education has had 2 – 3 students per year pursuing secondary school teacher certification with a Biology specialization. This proposed major will also provide a four-year plan for biology majors who decide not to pursue graduate or professional school immediately after earning their undergraduate degree and wish to plan for employment. It is therefore anticipated that several students per year who are currently pursuing a B.A. or B.S. Degree in Biological Sciences at UMBC will switch into the proposed program given the higher visibility that the program and career option will now have as a distinct major and four-year pathway. The proposed program will likely also provide a smoother pathway for transfer students to pursue certification in biology education at UMBC.

Students graduating from the proposed degree program should find a growing job market. The Bureau of Labor Statistics of the U.S. Department of Labor *Occupational Outlook Handbook 2012 – 2013 Edition* indicates a 7% growth in high school teacher positions nationally over the period 2010 – 2020. In addition, the *Handbook* notes that, “In addition to overall openings, many schools report difficulty filling teaching positions for certain subjects, including math, science... As a result, teachers with education or certifications to teach these specialties should have better job prospects.”

**ALTERNATIVE(S):** The Regents may not approve the program or may request further information.

**FISCAL IMPACT:** No additional funding is necessary. The program will be supported through tuition.

**CHANCELLOR’S RECOMMENDATION:** That the Committee on Education Policy and Student Life recommend that the Board of Regents approve the proposal from the University of Maryland, Baltimore County to offer the Bachelor of Arts in Biology Education.

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COMMITTEE RECOMMENDATION: Approval

DATE: June 3, 2014

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BOARD ACTION:

DATE:

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SUBMITTED BY: Joann Boughman

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jboughman@usmd.edu

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# UNIVERSITY SYSTEM OF MARYLAND INSTITUTION PROPOSAL FOR

X New Instructional Program  
       Substantial Expansion/Major Modification  
       Cooperative Degree Program

UMBC

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Institution Submitting Proposal

Biology Education

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Title of Proposed Program

B. A.

Fall 2014

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Degree to be Awarded

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Projected Implementation Date

13.1322

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Proposed HEGIS Code

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Proposed CIP Code

Biological Sciences

Philip Farabaugh

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Department in which program will be located

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Department Contact

410-455-3018

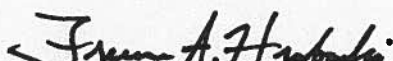
farabaug@umbc.edu

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Contact Phone Number

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Contact E-Mail Address

  
Signature of President or Designee

5/15/14  
Date

## **B. A. in BIOLOGY EDUCATION**

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

The vision of UMBC is to be “one of the nation's best public research universities of its size as it combines the traditions of the liberal arts academy, the creative intensity of the research university, and the social responsibility of the public university”<sup>1</sup> to the benefit of the citizens of Maryland. UMBC “supports the social and economic development of the State by contributing to an educated, informed, and creative citizenry; by the public service of our students, faculty, and staff; and through initiatives in K-16 education, workforce development, entrepreneurship, and technology commercialization in collaboration with public agencies and the corporate community”<sup>2</sup>.

This proposed Bachelor of Arts (B.A.) in Biology Education combines an existing Biological Sciences B.A. degree program with a selection of classes from the Department of Education required for teaching certification, and several elective courses recommended by the National Science Teachers Association. Students finishing the proposed degree program will be highly qualified biology teachers, certified to teach at the secondary level in the state of Maryland. The proposed degree is targeted at a small population of UMBC students (<10 per year) who currently pursue this combination of courses, but do not receive a degree indicative of their competency in this area. Adoption of this new Biology Education degree proposal is consistent with UMBC's mission of education and service, allowing our institution to respond to the continuing need for passionate, knowledgeable, well-trained high school biology teachers in the state and region. The STEM secondary educators produced by this program will go on to teach generations of Maryland science students, thereby increasing the overall scientific literacy of our general population. In addition, they will inspire many of these students to pursue higher education in STEM fields, responding to the need for a scientifically and technologically literate workforce in our state and region for the 21<sup>st</sup> century.

### **B. Adequacy of curriculum design and delivery to related learning outcomes:**

#### **B1. Courses in the Program**

Catalog descriptions of courses required for the degree are presented in Appendix I. An overview of the program with a four year completion plan is presented in Appendix II.

| <b>Major Requirements - Biology</b>  | <b>Total credits</b> |
|--|----------------------|
| BIOL 141 Foundations of Biology: Cells, Energy, Organisms                  | 4                    |
| BIOL 142 Foundations of Biology: Population Biology, Ecology and Evolution | 4                    |
| BIOL 300L Experimental Biology Laboratory                                  | 2                    |
| BIOL 302 Molecular and General Genetics                                    | 4                    |

|   |        |
|---|--------|
| BIOL 302L Molecular and General Genetics Laboratory   | 2      |
| BIOL 303 Cell Biology   | 4      |
| BIOL 305 Comparative Animal Physiology  | 3      |
| BIOL 397 Ethics and Integrity in Scientific Research  | 1      |
| BIOL 4XX Elective (BIOL 411, BIOL 414, BIOL 434)  | 4      |
| <b>Supporting Courses:</b>  |        |
| MATH 155 Applied Calculus   | 4      |
| STAT 350 Statistics with Application in Biological Sciences                                   | 4      |
| CHEM 101 Principles of Chemistry I  | 4      |
| CHEM 102 Principles of Chemistry II   | 4      |
| CHEM 102L Introductory Chemistry Lab I  | 2      |
| CHEM 351 Organic Chemistry  | 3      |
| PHYS 111 Basic Physics I  | 4      |
| PHYS 112 Basic Physics II   | 4      |
| <b>Requirements - Education</b>   |        |
| EDUC 310 Inquiry into Education   | 3      |
| EDUC 311 Psychological Foundations of Education   | 3      |
| EDUC 388 Inclusion and Instruction  | 3      |
| EDUC 410 Secondary Reading in the Content Area - The Teaching of Reading in Secondary Schools | 3      |
| EDUC 411 Secondary Reading in the Content Area - Part II                                      | 3      |
| EDUC 412 Analysis of Teaching and Learning  | 3      |
| EDUC 427 Teaching Science in the Secondary School   | 3      |
| EDUC 456 Internship in Secondary Education  | 12     |
| EDUC 457 Internship Seminar in Secondary Education  | 2      |
| <b>NSTA Required/Recommended courses</b>  |        |
| GES 110 Physical Geography  | 3      |
| GES 311 Weather and Climate   | 3      |
| PSYC 100 Introduction to Psychology   | 4      |
| PSYC 210 Psychology of Learning   | 3      |
| <b>General Education Requirements:</b>  |        |
| English Composition <i>(ENGL 100)</i>   | 3      |
| Mathematics <i>(MATH 155)</i>   | --     |
| Arts & Humanities <i>(3 courses)</i>  | 9      |
| Social Sciences <i>(PSYC 100, PSYC 210 +1 other)</i>  | 3      |
| Sciences + Lab <i>(BIOL 302, BIOL 302L)</i>   | --     |
| Culture <i>(2 courses)</i>  | 6      |
| Language <i>(proficient through 201 level)</i>  | 4 - 12 |

Students enrolled in this major must meet the general major requirements of the Biological Sciences department and the program requirements of the Education department.

## **B2. Educational Objectives and Intended Student Learning Outcomes**

The objective of the proposed Bachelor of Arts (B.A.) degree in Biology Education is to ensure that all students graduating with this degree will fulfill the requirements for biology teacher certification, grades 7-12, and also meet the Biology Standards for Science Teacher Preparation as defined by the National Science Teachers Association. The UMBC Biology Undergraduate Curriculum Committee, with input from the Education Department and encouragement from the Dean and the Provost, has developed a proposal that in four years, provides a curriculum which gives students a solid foundation in biology and also the coursework necessary for certification to teach biology at the secondary level. It was considered crucial that graduates be fully-trained biologists, capable of working in a range of technical positions in addition to secondary education. Therefore, it was reasoned that a successful B.A. Program in Biology Education at UMBC needs to possess two features: a curriculum equivalent to our regular Biological Sciences B.A. degree program, and one semester with no biology coursework, suitable for a teaching internship. In the selection of content courses, the first four semesters include the same core Biological Science courses for all of the BA/BS degrees in Biology. Also, these core courses are specifically designed to contain the historical perspectives of science and to achieve quantitative proficiency for all students. In addition, the curriculum seeks to expand the scientific perspective of graduates by requiring courses in other scientific disciplines (Environmental Science, Chemistry, Mathematics, Physics, Psychology, Ethics) as well as the incorporation of the history of science especially as it pertains to biology, microbiology, and molecular biology.

## **B3. General Education Requirements**

Students pursuing this B.A. degree will be subject to the standard General Education Program requirements in place at UMBC. Some of the GEP requirements will be met by courses required for the degree; the two Psychology courses recommended by NTSA will fulfill Social Sciences GEP requirements, the Mathematics requirement will be fulfilled by MATH 155, and the Science+ Lab requirement will be fulfilled by BIOL 302/302L.

## **B4. Specialized Accreditation or Graduate Certification Requirements**

In addition to fulfilling the requirements of a Bachelor of Arts degree in Biological Sciences, students graduating from the proposed degree program will fulfill the requirements for certification as secondary educators in the state of Maryland including successful completion of both the Praxis I and Praxis II (Science: Biology) examinations. This additional educational certification requirement and the number of credits per math and science course leads to a credit total for the degree of 127; however, the program can be completed in four years as described in Appendix II.

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

#### **C1. The proposed degree addresses the present and future needs of the state and region toward both the advancement of knowledge and the need to expand educational choices for minority students at institutions of higher education.**

The need for a scientifically and technically-literate work force is critical to efforts to grow jobs in the state and region, and increasingly these jobs require postsecondary education in a STEM field<sup>3,4</sup>. By increasing the supply of secondary education teachers with a Bachelor's degree in Biological Sciences, this proposed Biology Education degree program will respond to the continuing need for passionate, knowledgeable, well-trained high school biology teachers who can inspire their students to pursue postsecondary education in STEM fields. This will increase the scientific literacy of the overall population, while providing an increase in the STEM-educated work force in Maryland. Finally, by adding this degree program to those already offered, UMBC will increase the array of undergraduate programs available to its diverse student body (41.5% of UMBC BIOL majors identify as African-American, Hispanic, Asian or Native American).

#### **C2. The proposed degree is consistent with the Maryland State Plan for Postsecondary Education and the USM Strategic Plan.**

The creation of the proposed Bachelor of Arts degree in Biology Education at UMBC is entirely consistent with the specific goal set forth in the 2009 Maryland State Plan for Postsecondary Education to "increase in the number of higher education graduates in STEM fields with teaching credentials"<sup>3</sup> and with the goal of the USM 2010-2020 Strategic Plan to triple the number of STEM teachers graduating from USM institutions by 2020 by "expanding professional teacher development programs and pathways to certification and enhance options for career changers into all STEM fields"<sup>4</sup>.

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

The proposed program, the B.A. in Biology Education, will allow UMBC to produce outstanding teachers who are highly qualified to teach high school biology in order to help address the continuing need to improve secondary STEM education. This program responds to the need at UMBC to provide a clear pathway for students who wish to teach biology at the secondary school level, and students finishing this sequence will achieve a degree that specifically indicates their area of specialization and training. Over the last five years (2008 - 2013) the UMBC Department of Education has had 2 - 3 students per year pursuing secondary school teacher certification with a Biology specialization. This proposed major will also provide a four-year plan for biology majors who decide not to pursue graduate or professional school immediately after earning their undergraduate degrees and wish to plan for employment. Therefore, we anticipate that several students



per year who are currently pursuing a B.A. or B.S. degree in Biological Sciences at UMBC will switch into the proposed program given the higher visibility that the program and career option will now have as a distinct major advertised on the Biological Sciences web page and descriptive materials. The proposed program may also make it easier for transfer students to pursue certification in biology education at UMBC. Finally, having a prescribed Biology Education curriculum will enable UMBC to better track the number of its graduates who pursue careers as high school biology teachers.

Students graduating from the proposal degree program should find a growing job market. The Bureau of Labor Statistics of the US Department of Labor *Occupational Outlook Handbook 2012-2013 Edition* indicates a 7% growth in high school teacher positions nationally over the period 2010 - 2020 (a net increase of 71,900 jobs)<sup>5</sup>. Although this data is not broken down by subject area, the *Handbook* states, "From 2010 to 2020, a significant number of older teachers is expected to reach retirement age. These retirements will create job openings for new teachers. In addition to overall openings, many schools report having difficulty filling teaching positions for certain subjects, including math, science (especially chemistry and physics), English as a second language, and special education. As a result, teachers with education or certifications to teach these specialties should have better job prospects"<sup>5</sup>.

Locally, the latest forecast from the Maryland Department of Labor Licensing and Regulation (summer 2013) indicates a need for 1,991 secondary school teachers (excluding special education and vocational) in the period 2012 - 2014<sup>6</sup>, and their projections for 2010-2020 indicate a need for 7,130 secondary school teachers (excluding special education and vocational) in the current decade<sup>7</sup>. Additionally, the Bureau of Labor Statistics of the US Department of Labor (August 2013 data) indicate a 3.0% increase over the previous year in jobs in the Education and Health Care sector for Maryland<sup>8</sup> and a 2.5% increase for the Baltimore metropolitan region<sup>9</sup> compared to a 1.8% growth rate for US as a whole<sup>8</sup>.

## **E. Reasonableness of program duplication:**

UMBC already offers STEM teacher education degree programs for Chemistry and Physics, but currently students interested in teaching Biology at the secondary level do not have an integrated program that awards them a specific degree in that field. The proposed degree rectifies this deficiency and provides UMBC students wishing to pursue this career path with a degree that specifically indicates their field of expertise and qualification for secondary teaching in the Biological Sciences. Secondary education degree or certification programs with an emphasis on STEM in general, or the Biological Sciences in particular, exist at a number of USM institutions including Bowie State University, Coppin State University, Salisbury University, Towson University, the University of Maryland College Park, and the University of Maryland Eastern Shore. The ubiquity of these programs is an indication of the importance of STEM teacher preparation to the mission of Maryland institutions of higher education. Most of these programs are similar to each other and to the proposed UMBC degree in offering both a liberal arts Biology degree and secondary education training and certification. We expect

the program proposed here will attract a small number of students annually (< 10) mostly from students who have already chosen to pursue a Biological Sciences major at UMBC, and who wish to acquire teaching certification as a career goal. Therefore we do not anticipate a negative impact on existing programs at other institutions.

#### **F. Relevance to Historically Black Institutions:**

The proposed UMBC Biology Education degree program is similar to 1) the Biology Education Concentration offered by the Department of Natural Sciences at Bowie State University, 2) the Secondary Education (Biology track) degree program in the Department of Education at University of Maryland Eastern Shore, and 3) the major in Biology (Teacher Certification Track) in the Department of Natural Sciences at Coppin State University. Since the proposed UMBC degree is designed to serve the needs of students already pursuing this career choice at UMBC, and since we believe the majority of students pursuing the new degree will come from internal transfers from the large UMBC Biological Sciences major programs (currently 1600 majors), we do not anticipate a significant impact of this proposed degree on existing Biology secondary teacher education programs in existence at any of the Maryland HBIs.

#### **H. Adequacy of faculty resources:**

Eighteen full time faculty members from the Department of Biological Sciences will participate in the course offerings; all have a Ph.D. degree and are at the rank of Professor (6), Associate Professor (6), Assistant Professor (2) or Lecturer (4). Six full time faculty members from the Department of Education will participate in course offerings; five have doctoral degrees (Ph.D. or Ed.D.) and one has a Masters degree (M.Ed). Their ranks are as follows: Assistant Professor (3), Associate Professor (1), Lecturer (1), and other (1).

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

UMBC's Kuhn library currently has print or online subscriptions to all of the leading journals in the Biological Sciences and Biomedical fields, as well as most relevant journals for STEM and Biology education, and minimal additional library resources are anticipated. The President assures that appropriate library resources are available to support the needs of this program.

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

The courses required for this proposed degree are all currently offered by the Departments of Biological Sciences and Education at UMBC, and any additional need due to students pursuing the new degree can be accommodated within existing facilities and course offerings, so no additional physical facilities, infrastructure or instructional



equipment are anticipated. The President assures that appropriate physical facilities, infrastructure, and instructional equipment are available to support the needs of this program

**K. Adequacy of financial resources with documentation:**

The President assures that no new general funds from the State are required.

**L. Resources and Expenditures:**

See Tables 1 and 2.

| <b>TABLE 1: RESOURCES</b>                             |                |                |                |                |                |
|---|----------------|----------------|----------------|----------------|----------------|
| <b>Resources Categories</b>                           | <b>2014-15</b> | <b>2015-16</b> | <b>2016-17</b> | <b>2017-18</b> | <b>2018-19</b> |
| 1. Reallocated Funds <sup>1</sup>                     | 0              | 0              | 0              | 0              | 0              |
| 2. Tuition/Fee Revenue <sup>2</sup><br>(c+g below)    | \$20,136       | \$20,942       | \$21,780       | \$22,650       | \$23,556       |
| a. #F.T Students <sup>3</sup>                         | 2 (new)        | 2 (new)        | 2 (new)        | 2 (new)        | 2 (new)        |
| b. Annual Tuition/Fee<br>Rate (in state) <sup>4</sup> | \$10,068       | \$10,471       | \$10,890       | \$11,325       | \$11,778       |
| c. Annual Full Time<br>Revenue (a x b)                | \$20,136       | \$20,942       | \$21,780       | \$22,650       | \$23,556       |
| d. # Part Time Students                               | 0              | 0              | 0              | 0              | 0              |
| e. Credit Hour Rate                                   | 0              | 0              | 0              | 0              | 0              |
| f. Annual Credit Hours                                | 0              | 0              | 0              | 0              | 0              |
| g. Total Part Time<br>Revenue (d x e x f)             | 0              | 0              | 0              | 0              | 0              |

|   |          |          |          |          |          |
|---|----------|----------|----------|----------|----------|
| 3. Grants, Contracts, &<br>Other External<br>Sources <sup>5</sup> | 0        | 0        | 0        | 0        | 0        |
| 4. Other Sources  | 0        | 0        | 0        | 0        | 0        |
| TOTAL (Add 1 - 4)   | \$20,136 | \$20,942 | \$21,780 | \$22,650 | \$23,556 |

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<sup>11</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.

<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> We anticipate a steady state enrollment of 13 students in the program, including 11 UMBC students (mostly from the Biological Sciences major) who change their majors to Biology Education, and a projected two students per year who are new to UMBC.

<sup>4</sup> 2013-14 in state tuition rate with 4% annual increases.

<sup>5</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 2: EXPENDITURES**

| Expenditure Categories                                  | (Year 1) | (Year 2) | (Year 3) | (Year 4) | (Year 5) |
|---|----------|----------|----------|----------|----------|
| 1. Total Faculty Expenses<br>(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<br>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<br>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  | 0        | 0        | 0        | 0        | 0        |
| 5. Library  | \$500    | \$500    | \$500    | \$500    | \$500    |
| 6. New or Renovated Space                               | 0        | 0        | 0        | 0        | 0        |
| 7. Other Expenses                                       | 0        | 0        | 0        | 0        | 0        |
| TOTAL (Add 1 - 7)                                       | \$500    | \$500    | \$500    | \$500    | \$500    |

### **M. Adequacy of provisions for evaluation of program:**

Teaching effectiveness by members in the Department of Biological Sciences is regularly assessed as a part of our post-tenure review process for tenured faculty or during regular yearly assessment of non-tenured faculty. During post-tenure review faculty submit the results of the Student Course Evaluation Questionnaire (SCEQ) and describe any course development or other preparatory work they may have done during the previous year. For non-tenure track or untenured faculty, a review of their teaching effectiveness can be triggered by an end of year assessment of their SCEQ data. In addition, the department chair meets with all faculty members on at least a yearly basis to discuss their teaching.

Students pursuing the proposed Biology Education degree program will take the Praxis I and Praxis II examinations by the time they graduate. These exams are required for secondary teaching certification. The Praxis I exam assesses student learning in the areas of Reading, Writing and Mathematics, while the Praxis II exam is subject specific and assesses content knowledge in the field of Biology.

### **N. Consistency with the State's minority student achievement goals:**

One of the goals of the 2009 UMBC Diversity plan is the "recruitment and support of a diverse undergraduate student body"<sup>10</sup>. The student population in the existing Biological Sciences majors is already quite diverse, with the following makeup (compared to UMBC overall):

| <u>BIOL (F2013)</u> |       | <u>UMBC (F2013)</u> |       |
|---------------------|-------|---------------------|-------|
| male                | 41.0% | male                | 54.7% |
| female              | 59.0% | female              | 45.2% |
| Black               | 16.9% | Black               | 15.9% |
| Native American     | 0.1%  | Native American     | 0.1%  |
| Asian               | 35.2% | Asian               | 19.8% |
| Hispanic            | 4.9%  | Hispanic            | 5.7%  |
| White               | 29.5% | White               | 45.2% |
| Other               | 13.4% | Other               | 13.2% |

## **Appendix I: Catalog Listings of Required Courses**

### **BIOLOGY COURSES:**

#### **BIOL 141 Foundations of Biology: Cells, Energy and Organisms. [4]**

This course provides a broad overview of contemporary biological concepts. Major topics include structure and synthesis of nucleic acids and proteins, molecular genetics, prokaryotic and eukaryotic cell structure and function, biochemistry of energy transformation, and animal and plant development and physiology. This course is designed to prepare students for upper level biology core and elective courses. It is one of two introductory courses (BIOL 141 & 142) designed exclusively for BIOL, BIOC and BIOI majors; either course can be taken first.

#### **BIOL 142 Foundations of Biology: Population Biology, Ecology and Evolution. [4]**

This course provides a broad overview of contemporary biological concepts. Major topics include Mendelian genetics, population genetics, evolution by natural selection, other evolutionary processes (genetic drift, gene flow, non-random mating and mutation), speciation, species interactions, ecosystems and niches, and biogeochemical cycles. It is one of two introductory courses (BIOL 141 & 142) designed exclusively for BIOL, BIOC and BIOI majors; either course can be taken first.

#### **BIOL 302 Molecular and General Genetics. [4]**

Modern principles of heredity have been established through studies at the molecular, cellular and organismic levels. The course includes fundamental information on the structure of a gene, its expression and organization as deduced from analysis of viral and prokaryotic systems, the transmission of genetic material in eukaryotic systems, the interaction of genes in populations and the application of fundamental genetic principles to problems of human heredity. Prerequisite: BIOL 141 and 142, CHEM 101 or 123 and sophomore standing. Pre- or corequisite: CHEM 102 or 124.

#### **BIOL 302L Molecular and General Genetics Laboratory. [2]**

A laboratory course designed to illustrate fundamental genetic principles by experimentation. Such principles include the nature of genetic material, transfer of genetic information in prokaryotic and eukaryotic systems, organization and regulation of gene expression, Mendel's rules of heredity, linkage and crossing over, and genetic variation. Students will be expected to work independently, spending periods of time outside the scheduled lab period collecting data. Prerequisite: BIOL 302 completed with a grade of C or better.

#### **BIOL 303 Cell Biology. [4]**

A modern treatment of cell structure and function with emphasis on the molecular architecture, biochemistry and regulatory mechanisms common to all cells. Topics include membrane structure, function and transport; molecular mechanisms of energy metabolism and its associated organelles; the structural and molecular basis for the expression of genetic information; the organelles involved in the regulation of cell shape and motility; selected cell functions, growth, reproduction and their control. This course is designed for students interested in the biological sciences, biochemistry and the allied health professions. (Spring & Fall) Prerequisites: BIOL 302, CHEM 102; CHEM 351 strongly recommended.

**BIOL 300L Experimental Biology Laboratory. [2]**

An upper level course of experiments designed to give students the essential laboratory and critical thinking skills in experimental design, implementation and analysis that every biologist should know. This knowledge base is required for succeeding in further BIOL laboratory courses and for working in a research laboratory. Required of all BIOL majors and a prerequisite for all upper level BIOL laboratory courses. Prerequisites: CHEM 102, CHEM 102L and BIOL 302.

**BIOL 305 Comparative Animal Physiology. [3]**

Functional features of whole organisms and their component organs and organ systems will be studied. Emphasis will be on ways in which diverse organisms at various phylogenetic levels perform similar functions. Examples of topics include osmoregulation, gas exchange, control systems, sensors, effectors, brain and behavior. Prerequisite: BIOL 303 completed with a grade of C or better; PHYS 112 (which may be taken concurrently as co-requisite)

**BIOL 397 Ethics and Integrity in Scientific Research. [1]**

Individuals involved in contemporary scientific research have ethical responsibilities for their conduct. The goal of this course is to provide students considering a career in scientific research with a framework for establishing appropriate scientific integrity. A variety of relevant topics will be discussed, including fraud and misconduct, peer review, obligations and rights of students and mentors, ethical conduct in animal and human experimentation, ownership of data, reagents, intellectual property, authorship and conflict of interest. Note: Permission of course coordinator required.

**BIOLOGY 400-level ELECTIVE CHOICES (Choose 1):****BIOL 411 Bacterial Physiology. [4]**

The combined approaches of bacterial genetics, molecular biology, and biochemistry are applied to the study of bacterial physiological processes. An emphasis is placed on examining adaptation strategies used by bacteria upon encountering alterations in environment. Topics include mechanisms of transcriptional and postranslational control, regulation of carbon and nitrogen metabolism, biosynthesis, energy transduction, signal transduction systems and bacterial development. Prerequisites: BIOL 302 and BIOL 303 or consent of instructor.

**BIOL 414 Eukaryotic Genetics and Molecular Biology. [4] (WI)**

Genetics and molecular biology of lower and higher eukaryotes and their viruses. The course will focus on the maintenance and expression of genetic material as it relates to cell growth and development. It will cover current topics in the molecular genetics of several lower and higher eukaryotes at an advanced level, including mechanisms of genetic control that operate at the level of DNA replication, transcription and translation. Topics to include the molecular basis of phenomena such as gene amplification, global control of transcription initiation, protein sorting and secretion, control of yeast mating type as a model for development, the origin of antigen diversity, oncogenesis, pattern formation in *Drosophila* and sex determination in mammals. Prerequisite: BIOL 302 and 303 or consent of instructor

**BIOL 434 Microbial Molecular Genetics. [4]**

Application of the combined approaches of microbial genetics, molecular biology, and biochemistry to the study of fundamental biological processes are demonstrated. The research literature is used to describe the current state of knowledge of the molecular mechanisms of microbial gene expression and the genetic biochemistry of chromosome structure, DNA replication, repair and recombination. Prerequisites: BIOL 302, 303 or consent of instructor. BIOL 430 or CHEM 437 is recommended.



## **MATH/STATISTICS COURSES:**

### **MATH 155 Applied Calculus. [4]**

Basic ideas of differential and integral calculus, with emphasis on elementary techniques of differentiation and integration with applications, are treated in this course. Technology will be utilized to enhance understanding of the concepts and their applications. Not recommended for students majoring in mathematics, computer science, engineering, or physical sciences. Note: Credit will not be given for both MATH 151 and 155. Prerequisite: Math 106 or a qualifying score on the mathematics placement test.

### **STAT 350 Statistics with Applications in Biological Sciences. [4]**

Organization and presentation of data, summary of descriptive measures, probability, binomial and normal distributions, sampling natural populations and the estimation of population parameters, hypothesis testing, chi-square analysis, experimental designs and the analysis of variance, linear regression and correlation, and non-parametric statistics. Students will be introduced to statistical computing. All the statistical procedures will be illustrated using data from biology and the health sciences. **Note:** Not open to students who have passed or are concurrently taking STAT 351, 355, 356, 453 or CMPE 320. This course does not satisfy the statistics requirement for computer science majors and does not qualify as part of the mathematics major or minor. **Prerequisite:** MATH 150 or placement into 151 or 155.

## **CHEMISTRY COURSES:**

### **CHEM 101 Principles of Chemistry I. [4]**

An introduction to chemistry for science majors and other students who require thorough grounding in the principles of chemistry. Topics treated include the atomic-molecular theory of matter, stoichiometry, states of matter, chemical nomenclature, energetics of chemical and physical processes, solutions, periodic properties, VSEPR, molecular orbital theory and chemistry of familiar elements.

Prerequisites: Working knowledge of elementary algebra. MATH 150 highly recommended.

### **CHEM 102 Principles of Chemistry II. [4]**

Principles of chemical and physical equilibrium, liquids and solids, elementary thermodynamics, electron and proton transfer reactions, electrochemistry, chemical kinetics and a further study of the periodic properties of the elements.

Prerequisites: CHEM 101.

### **CHEM 102L Introductory Chemistry Lab I. [2]**

Companion course to CHEM 102, intended for all students who require two or more years of chemistry.

Prerequisites: CHEM 101. Corequisites: CHEM 102.

### **CHEM 351 Organic Chemistry I. [3]**

The chemistry of aliphatic and aromatic compounds, including bonding, stereochemistry and reactions of functional groups. Reaction mechanisms, synthetic methods and characterization of organic molecules.

Prerequisites: CHEM 102.

## **PHYSICS COURSES:**

**PHYS 111 Basic Physics I. [4]**

Three lectures and one two-hour laboratory period a week. A general physics course intended primarily for students in psychology, biology and health related sciences. Topics include mechanics, heat and sound.

Notes: This course satisfies the minimum requirements of medical and dental schools. Recommended Preparation: High school mathematics, including trigonometry or MATH 150.

**PHYS 112 Basic Physics II. [4]**

Continuation of PHYS 111. Topics include electricity, magnetism, optics and modern physics.

Prerequisite: PHYS 111

**EDUCATION COURSES:****EDUC 310 Inquiry into Education. [3]**

This course introduces reflective practice as a foundation for the study of teaching and learning. Inquiry as a way of learning about schools, as well as about self as teacher and learner will be explored through reflection on students' experiences with children and schooling. The macro- and micro-socio-cultural contexts of education across diverse settings will be examined. Students will draw upon anthropological and sociological research methods to study the dynamics of classrooms, schools and communities. An in-school experience of 24 hours is required included in this course. Prerequisites: permission of the department.

**EDUC 311 Psychological Foundations of Education [3]**

The psychology of school learning will be explored. There will be an overview of theories of teaching, learning, motivation and related research, including the philosophical assumptions underlying each - within the dynamics of context of class, culture, race and gender issues. The overall focus will be an exploration of ways of knowing and ways that learners construct knowledge. Emphasis is placed on empirical findings and their implications for the process of schooling. Topics include instructional models and objectives, conditioning, skill acquisition, verbal learning, memory, problem-solving, creativity and discovery learning.

**EDUC 388 Inclusion and Instruction [3]**

This course is designed to introduce students to strategies for differentiating instruction within general education classrooms. The course examines the legal, philosophical and programmatic underpinnings of instructional inclusion, broadly defined. Addressed in the course are approaches for adapting the curriculum—especially in the areas of reading, writing and math—to meet the needs of socio-culturally, linguistically, cognitively (e.g., dyslexic, dyscalculic) and behaviorally diverse student populations, including students identified traditionally as having special needs (e.g., gifted and talented, physically challenged). Prerequisites: Permission of the department.

**EDUC 410 Secondary Reading in the Content Areas - The Teaching of Reading in Secondary Schools. [3]**

Major approaches to teaching reading to students in grades 7 to 12. Emphasis on skills in all content areas ranging from English to science, which the secondary teacher can apply toward improving secondary students' reading ability and their attitude toward reading. Emphasis is on literacy as a tool to increase learning. Prerequisites: Admission to teacher education and permission of the department.

**EDUC 411 Secondary Reading in the Content Area - Part II. [3] (WI)**

This course is designed to develop competency in the utilization of reading and writing strategies, assessments, vocabulary building, comprehension and special-needs adaptations. The secondary certification candidates should be able to demonstrate competency in their knowledge of contemporary theory, research, wisdom of practice, modeling and analysis, and protected practice. Field experiences are required in this course.

Prerequisites: EDUC 410 and permission of the department.

**EDUC 412 Analysis of Teaching and Learning. [3]**

This course is an introduction to a systematic approach to instruction. Special emphasis is placed on developing performance objectives, planning teaching strategies and formulating evaluation instruments to assess learning. The use of technological resources in instructional planning is emphasized. Students will develop skills to create meaningful learning experiences for students of diverse cultural, ethnic, linguistic and intellectual backgrounds. These skills are then practiced in actual peer teaching situations.

Prerequisites: EDUC 310, EDUC 311 and permission of the department.

**EDUC 427 Teaching Science in the Secondary School. [3]**

This course develops a holistic, interdisciplinary understanding of science. Develops skills at designing, using and assessing various developmentally appropriate teaching strategies. Focuses on inquiry and action. Active learning strategies/tools, including reflective inquiries, demonstrations, constructions, field trips, observations and authentic teaching experiences. Use of educational technologies to enhance the teaching and learning of science. Emphasis on adapting subject matter to learner diversity. Field experiences are required in this course.

Prerequisites: EDUC 412 and permission of the department.

**EDUC 456 Internship in Secondary Education. [12]**

This intensive internship provides students with the opportunity to take progressive responsibility for teaching in their specialty area and developing professional teaching competencies in a professional development school with support from a mentor teacher and a university supervisor.

Prerequisites: Completion of all methods courses required for certification and permission of the department.

**EDUC 457 Internship Seminar in Secondary Education. [2]**

The seminar provides a forum for discussing and processing field experiences and current issues/problems in teaching and learning. The seminar has been designed to help teacher candidates analyze the many facets of teaching and to become a reflective practitioner. Topics that are addressed include classroom management, assessment strategies, the culture of schools, developing evidence-based portfolio and becoming a professional.

Prerequisites: Completion of the Phase I internship and permission of the department.

**REQUIRED/NSTA RECOMMENDED GEO/ENVIRONMENTAL SCIENCE AND  
SOCIAL SCIENCES ELECTIVES FOR CERTIFICATION IN BIOLOGY**

**GES 110 Physical Geography [3]**

Study of the principles and processes of climate, earth materials, landforms, soils and vegetation that give logic to their integrated patterns of world distribution.

**GES 311 Weather and Climate [3]**

This course offers an introduction to the physical processes that control weather and climate. Topics covered include the mechanics of atmospheric behavior, weather systems, the global distribution of climates and their causes, as well as various topics related to climatology. Recommended Preparation: GES 110

**PSYC 100 Introduction to Psychology [4]**

Introduction to the basic concepts of psychology. Emphases on interpretation of psychological data, biological bases of behavior, perception, learning, individual differences, personality, behavior pathology and social psychology.

**PSYC 210 Psychology of Learning [3]**

Basic problems in the psychology of learning: reinforcement and patterns of reinforcement, extinction, generalization and discrimination, verbal learning, transfer of training, retention and forgetting, concept learning. Prerequisite: PSYC 100.

## **Appendix II: Degree Program overview and four year plan (127 credits)**

### **Overview of the Program**

The overall number of credits required to complete the B.A. degree program is 127 - 130 depending on the number of Language courses taken.

There are 63 credits (17 courses) required for the Biology portion of the degree with following breakdown of courses by discipline/area:

- Biology: 28 credits
- Chemistry: 13 credits
- Mathematics: 8 credits
- Physics: 8 credits
- Earth/Space Science: 6 credits

There are 33 credits (9 courses) required for the Education portion of the degree. In addition, PSYC 100 (4 cr) and PSCH 210 (3 cr) are required and are also used as GEP Social Science electives.

General Education Program (GEP) courses required for all B.A. degree students:

- Two Global Culture GEP courses (C)
- Three Arts and Humanities GEP courses in at least two academic fields (AH)
- Three Social Sciences GEP courses in at least two academic fields (SS)

Additional UMBC requirements:

- ENGL 100
- One Writing Intensive course (WI; satisfied by EDUC 411)
- Two Physical Education courses (non-academic)

The proposed program includes at least one semester each of chemistry, physics, earth science, and math, in keeping with the recommendations of the National Science Teachers Association (NSTA) for secondary school certification in Biology. In the final semester the full semester load is devoted to the internship.

### **Four year plan for completion of the B.A. in Biology Education (next page)**

| <b>Fall, First Year (16.5 credits)</b>                        | <b>Spring, First Year (15.5 credits)</b>                |
|---|---|
| <b>MATH 155</b><br><b>Applied Calculus [4]</b>                | <b>CHEM 101</b><br><b>Principles of Chemistry I [4]</b> |
| <b>BIOL 141</b><br><b>Foundations of Biology [4]</b>          | <b>BIOL 142</b><br><b>Foundations of Biology [4]</b>    |
| <i>PE Elective [1.5]</i>                                      | <i>PE Elective [1.5]</i>                                |
| <b>PSYC 100</b><br><b>Introduction to Psychology (SS) [4]</b> | <b>GES 110</b><br><b>Physical Geography [3]</b>         |
| <i>ENGL 100</i><br><i>Composition [3]</i>                     | <i>Arts &amp; Humanities Elective I [3]</i>             |

| <b>Fall, Second year (17 credits)</b>                        | <b>Spring, Second year (17 credits)</b>                                   |
|--|---|
| <b>BIOL 302</b><br><b>Genetics and Molecular Biology [4]</b> | <b>BIOL 303</b><br><b>Cell Biology &amp; Biochemistry [4]</b>             |
| <b>CHEM 102</b><br><b>Principles of Chemistry II [4]</b>     | <b>PHYS 111</b><br><b>Basic Physics I [4]</b>                             |
| <b>PSYC 210</b><br><b>Psychology of Learning [3] (SS)</b>    | <b>CHEM 102L</b><br><b>Introductory Chemistry Lab [2]</b>                 |
| <b>EDUC 310</b><br><b>Inquiry into Education. [3]</b>        | <b>EDUC 311</b><br><b>Psychological Foundations of Education [3]</b>      |
| <b>Arts &amp; Humanities Elective II [3]</b>                 | <b>Culture Elective I [3]</b>   |
|  | <b>BIOL 397</b><br><b>Ethics and Integrity in Scientific Research [1]</b> |

| <b>Fall, Third year (16 credits)</b>  | <b>Spring, Third year (16 credits)</b>                             |
|---|--|
| <b>BIOL 300L</b><br><b>Experimental Biology Lab [2]</b>                       | <b>BIOL 305</b><br><b>Comparative Animal Physiology [3]</b>        |
| <b>PHYS 112</b><br><b>Basic Physics II [4]</b>                                | <b>BIOL 4XX elective [4]</b>                                       |
| <b>CHEM 351</b><br><b>Organic Chemistry I [3]</b>                             | <b>EDUC 388</b><br><b>Inclusion and Instruction [3]</b>            |
| <b>STAT 350</b><br><b>Statistics with Applications in Biological Sci. [4]</b> | <b>EDUC 410</b><br><b>Reading in the Content Area – Part I [3]</b> |
| <b>EDUC 412</b><br><b>Analysis of Teaching and Learning [3]</b>               | <b>Culture Elective II [3]</b>                                     |

| <b>Fall, Fourth year (17 credits)</b>                                  | <b>Spring, Fourth year (12 credits)</b>                                 |
|--|---|
| <b>BIOL 302L</b><br><b>Genetics and Molecular Biology Lab [2]</b>      | <b>EDUC 456</b><br><b>Internship in Secondary Education [10]</b>        |
| <b>GES 311</b><br><b>Weather and Climate [3]</b>                       | <b>EDUC 457</b><br><b>Internship Seminar in Secondary Education [2]</b> |
| <b>Arts &amp; Humanities Elective III [3]</b>                          |   |
| <b>Social Science Elective (not PSYC) [3]</b>                          |   |
| <b>EDUC 427</b><br><b>Teaching Science in the Secondary School [3]</b> |   |
| <b>EDUC 411</b><br><b>Reading in the Content Area– Part II [3]</b>     |   |



### **Appendix III: Citations**

- 1) *UMBC Mission statement:* <http://www.umbc.edu/aboutumbc/mission.php>
- 2) *UMBC Framework for 2016:* <http://www.umbc.edu/provost/PDFs/frameworkfinal.pdf>
- 3) *2009 Maryland State Plan for Postsecondary Education:*  
<http://mhec.maryland.gov/highered/about/meetings/commissionmeetings/6-17-09/2009draftmdstateplanforpostsecondaryeducationais+memo.pdf>
- 4) *2010-2020 USM Strategic Plan Powering Maryland Forward:*  
<http://www.usmd.edu/usm/chancellor/specialdocs/>
- 5) *U.S. Department of Labor Bureau of Labor Statistics, Occupational Outlook Handbook, 2012-13 Edition, High School Teachers*  
<http://www.bls.gov/ooh/education-training-and-library/high-school-teachers.htm>
- 6) *Maryland DLLR Division of Workforce Development and Adult Learning, Education, Training and Library Occupations - Maryland Occupational Projections 2012-2014*  
<http://www.dllr.state.md.us/lmi/iandoprojshort2/occgroup25short.shtml>
- 7) *Maryland DLLR Division of Workforce Development and Adult Learning, Education, Training and Library Occupations - Maryland Occupational Projections 2010-2020*  
<http://www.dllr.state.md.us/lmi/iandoproj/occgroup25.shtml>
- 8) *US Department of Labor Bureau of Labor Statistics, Economy at a Glance*  
<http://www.bls.gov/eag/eag.md.htm>
- 9) *US Department of Labor Bureau of Labor Statistics, Economy at a Glance*  
[http://www.bls.gov/eag/eag.md\\_baltimore\\_msa.htm](http://www.bls.gov/eag/eag.md_baltimore_msa.htm)
- 10) *UMBC Diversity Plan:*  
[http://www.umbc.edu/provost/PDFs/UMBC\\_Diversity\\_Plan\\_030409.pdf](http://www.umbc.edu/provost/PDFs/UMBC_Diversity_Plan_030409.pdf)