Proposal to revise the Biosciences Curriculum at Rice
Including creation of a BA EEB and departmental minors in BCB and EEB

Overview of existing biosciences curriculum
Currently there are four biosciences majors that have been jointly managed by the Depts. of Biochemistry and Cell Biology (BCB) and Ecology and Evolutionary Biology (EEB). These degrees are BA Biological Sciences [a broad degree], BA Biochemistry and Cell Biology [a degree focused on biology at the level of the cell or smaller with a largely pre-professional audience], BS Biochemistry and Cell Biology [a degree for students with research career objectives focused on biology at the level of the cell or smaller with a largely pre-professional audience], and BS Ecology and Evolutionary Biology [a degree for students with research career objectives focused on biology at or above the level of the organism]. In addition, all the courses in the two departments are listed under the single designation BIOS and appear in a single part of the general announcements called “Biosciences” (Figure 1A).

Changes in curriculum
We are planning to: 1) make revisions to the content (i.e. requirements) of the BA in BCB, BS in BCB, and BS in EEB degrees, 2) create a new BA in Ecology and Evolutionary Biology, 3) leave the content of the BA in Biological Sciences unchanged and leave it as jointly administered degree under the BCB and EEB depts., 4) retire the BIOS code and replace it with a pair of department specific codes (BIOC [BCB] and EBIO [EEB]), 5) change the oversight of the BCB and EEB degrees to the BCB and EEB departments, respectively. 6) create a minor in each department that is overseen by a single department (Figure 1B). It is our understanding that, technically, we may perhaps need approval from the CUC for #2 and #6 only [the CUC charge notes “approval should be gotten for revisions of existing minors and majors” without specifying how serious the changes must be to existing majors for CUC involvement] but we are presenting an overview of the entire plan since these are popular degrees and changes are being proposed beyond the addition of a single BA and a pair of minors.

Figure 1
A – Current structure

BCB

EEB

BA Biol Sci
BA BCB
BS BCB
BS EEB
“BIOS”

B – Proposed structure

BCB

EEB

BA BCB
BS BCB
minor BCB
“BIOC”

BA Biol Sci
BA EEB
BS EEB
minor EEB
“EBIO”
Why are we doing this?

1) **Content of existing degrees** - The joint administration of the degrees has created “gridlock” – too many constituencies with different areas of expertise have made it difficult to innovate. The change in administrative structure of the majors is the logical time to have these departmental revisions occur.

2) **New BA EEB** - In terms of symmetry, the current selection of degrees is unbalanced. When the last revision of Bioscience degrees was done, the proposed BA EEB was dropped late in the process as a way of preventing triple majoring in BAs in the Biological Sciences. There is a substantial demand for such a degree and we propose now to prevent triple majoring by prohibiting the BA in Biological Sciences from being combined with either of the other Biosciences BA degrees.

3) **BA Biol. Sci** - The broad BA Biological Sciences degree fits a two-department model well. A committee with members from the two departments will continue to manage this degree with advising shared between the two departments.

4) **Dept. Codes** - The BIOS code is confusing to students and to the Registrar. With departmental codes, this confusion will be eliminated after a period of adjustment. During that period we will continue to list the previous BIOS course number in the course description. In this document we have kept the course numbers the same but only have changed to departmental codes. As we implement this revision, it is likely that the numbers assigned to some courses will change as well (e.g. BIOS 202 is listed here as EBIO 202 but could become something like EBIO 101).

5) **Dept. specific degrees** - This is the dominant structure at Rice and it fits with the organizational structure of the university.

6) **Minors** - There is a demand for minors and the revision of other aspects of the Biosciences curriculum is an appropriate time for the addition of these minors.

Overview of target audiences for each degree

The three BA degrees are targeted towards pre-professionals (e.g. pre-law, pre-med) and for students doubling this major with a non-science degree (for the BA EEB). Depending on the area of biology in which students wish to concentrate their studies, they would choose one of the departmental degrees (BA BCB, BA EEB) or the broad jointly administered degree (BA Biol Sci). The BS degrees are more rigorous degrees with a strong emphasis on and requirements for upper level coursework (BS BCB) or research (BS EEB) – most students would enter the workforce with this as their terminal degree or would continue on to graduate school in a BCB or EEB field, respectively.

Overview of degree emphasis

The BCB degrees emphasize coursework in the areas of biochemistry and cell biology together with an in-depth program of study in the physical sciences, which is required for biochemistry courses. The EEB degrees emphasize coursework in the areas of ecology and evolutionary biology with less emphasis on physical sciences but more emphasis on a broad training in biology. The shared degree has a broad emphasis on different areas of biology but less depth in any particular areas of biology (Table 1 and 2).
Stand-alone descriptions of majors

**BA Biological Sciences** - This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate or Professional school. Coursework is designed to emphasize a broad understanding of the full range of biological disciplines.

**BA Biochemistry and Cell Biology** - This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate or Professional school. Coursework is designed to emphasize a broad understanding of cell biology and biochemistry that culminates in a required capstone 400-level course that incorporates primary scientific literature, presentations and writing in an advanced topic.

**BA Ecology and Evolutionary Biology** - This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate or Professional school. This degree is well suited for students with an additional major that is not in the sciences. Coursework is designed to emphasize a broad understanding of basic biology together with an in-depth knowledge of ecology and evolutionary biology that culminates in a required capstone 400-level course that incorporates primary scientific literature, presentations and writing in an advanced topic. Students are strongly encouraged to take advantage of study abroad opportunities.

**BS Biochemistry and Cell Biology** - This degree path is intended for students pursuing a wide range of careers in the life sciences with an emphasis on research. Students graduating from this degree path typically go on to Graduate or Professional school. Coursework is designed to build a deeper understanding of cell biology and biochemistry through additional upper level coursework in topics that can include biochemistry, biophysics, cell biology, genetics and developmental biology. The BS culminates in two required capstone 400-level courses that incorporate primary scientific literature, presentations and writing in advanced topics. Additionally students in this degree program are strongly encouraged to pursue their research interests.

**BS Ecology and Evolutionary Biology** - This degree path is intended for students pursuing a wide range of careers in the life sciences with required research in organismal biology. Students graduating from this degree path typically go on to Graduate or Professional school or enter the workforce with this as their terminal degree. Coursework is designed to emphasize a broad understanding of basic biology together with an in-depth knowledge of ecology and evolutionary biology that culminates in a required capstone 400-level course that incorporates primary scientific literature, presentations and writing in an advanced topic. Additionally students in this degree program are required to conduct independent research under the supervision or co-supervision of an EEB faculty member (though the research can take place in other locations or institutions such as the Texas Medical Center or at field sites throughout the world). Students are strongly encouraged to take advantage of study abroad opportunities.

**Minor BCB** - The BCB minor is intended for the large number of students with an avid interest in biochemistry and cell biology but whose major interests are in other departments. Coursework
requires the 300-level courses Cell Biology (BIOC 341) and Biochemistry (BIOC 301) to build a foundational understanding of Biochemistry and Cell Biology.

Minor EEB - The EEB minor is intended for the large number of students with an avid interest in ecology and evolutionary biology but whose major interests are in other departments. Coursework requires introductory biology course sequence (BIOC 201, EBIO 202), the introductory lab (EBIO 213), and four 300-level lecture courses in EBIO.
EEB Department Majors

The learning outcomes and associated structures of the proposed EEB degrees are:

1) **Base of knowledge in physical sciences**
   Relevant curriculum features:
   - CHEM 121 (+123) - Introductory chemistry (and lab)
   - PHYS 125 - Introductory Physics
   - Non-EEB courses in selected departments to build relevant strengths

2) **Strong quantitative skills**
   Relevant curriculum features:
   - MATH 101/102 - Introductory Calculus
   - STAT course (range of options)

3) **Technical and practical skills in biology**
   Relevant curriculum features:
   - BIOC 111/211 - Introductory Biology Lab
   - EBIO 213 - Introductory Lab in Ecology & Evolutionary Biology
   - 2 advanced EBIO lab courses

4) **Breadth of knowledge in biology**
   Relevant curriculum features:
   - BIOC 201 / EBIO 202 - Introductory Biology
   - 300-level BIOC course from selected list [not including some such as BIOC 307]

5) **Core knowledge of evolution**
   Relevant curriculum features:
   - EBIO 334 Evolution

6) **Verbal and written communication skills**
   Relevant curriculum features:
   - Capstone communication course for Seniors (combine with paper from EBIO 213 and assignment from EBIO 334 for assessment of learning outcomes at three different stages in the degree. Each course is required of all EEB majors and come in the freshmen, sophomore/junior, and senior years)
   - Component of nearly all courses in EEB Dept.

7) **Knowledge of natural history**
   Relevant curriculum features:
   - EBIO 213 (other labs)
   - EBIO 213 includes a field natural history examination
   - Feature of majority of EBIO courses [all but 333 and 338]

8) **Opportunity to achieve depth of knowledge in some area within EEB**
   Relevant curriculum features:
- Establisment of optional tracks to guide student learning
- Conservation Biology / Environmental Biology, Evolutionary Biology, Evolutionary Genetics and Genomics, Human Biology
- Set of suggested courses both within EEB [lecture and lab] and outside of EEB to build knowledge in a focal area
- Some tracks have an informal structure with selections of courses in different categories while others have a more formal and detailed structure that works to build a specific set of skills and competencies and are more appropriate for students pursuing a BS
- These will appear in the General Announcements and the EEB departmental web page but will not appear on student diplomas.

9) Requirements should represent skills or knowledge that are critical for all, or almost all, EEB majors.
   Relevant curriculum features:
   - This doesn't link directly to a course or lists of courses but rather drives the smaller number of required courses than we have had in the past and the large degree of flexibility we have tried to have in the major.

10) The BS is distinguished from the BA by independent research
The BA is likely to be a degree for pre-professionals (pre-law, pre-med) or for students doubling this major with a non-science degree. The BS is a more rigorous degree with a strong emphasis on research – students would enter the workforce with this as their terminal degree or would continue on to graduate school in an EEB field.
   Relevant curriculum features for the EEB BS that are required for the EEB BA:
   - EBIO 306
   - EBIO 403/404

11) Double-majors
The general biology degree serves a distinct purpose in terms of allowing students to balance their knowledge across the breadth of biology. It is likely that without this degree being retained that there would be no such option and students would have to choose a more narrow degree with a dept. However, it will be easy to double the BA Biological Sciences with the BA EEB (and likely the BA BCB). We propose that students not be allowed to combine the BA Biological Sciences with either of the other BA degrees in the Biosciences or with either of the minors in the Biosciences. The Economics department already does this for their majors, where students are not permitted to double major in ECON and MTEC.

We would not prohibit the doubling of the BA EEB and BA BCB because there is less overlap between these degrees. We are not proposing to prohibit the combination of the EEB minor with a BA or BS in BCB or the combination of the BCB minor with a BA or BS in EEB. Likewise, combining the minors with a non-biosciences degree would not be prohibited.

12) Peer institutions
An example of a school with a degree program similar to the one described here is Harvard. A brief description of their requirements is appended here. A more complete description can be found at:
13) General Announcements
See Appendix 1 for the GA information for EEB.
REQUIREMENTS FOR THE EEB DEGREES (BA and BS)

Non-biology courses (21 credits):
MATH 101/102 - Single Variable Calculus I and II [6 credits]
STAT course or EBIO 338 - Design and Analysis of Biological Experiments [3 or 4 credits]
CHEM 121/123 - General Chemistry with Laboratory [4 credits]
PHYS 125 - General Physics I [4 credits]
One natural sciences or engineering course [3 credits]

General Biology (6 credits):
BIOC 201 / EBIO 202 - Introductory Biology I and II [6 credits]

Biology Labs (6 credits):
BIOC 211 - Introductory Experimental Biosciences [2 credits]
EBIO 213 - Introductory Lab in Ecology and Evolutionary Biology [1 credits]
Two 300 or 400 level labs in EBIO or BIOC [2 credits]

Non-EEB Biology course (3 credits):
300 or 400 level BIOC lecture course [3 credits]

Advanced EEB courses (12 credits):
EBIO 334 - Evolution
Three EBIO lecture courses at 300 or 400 level [12 credits]

SR scientific communication course (2 credits):
EBIO 4xx [2 credits]

In addition to these requirements, for the BS degree -
Independent research (BS only - 12 credits):
EBIO 306 – Independent Research [for at least 2 credits]
EBIO 403/404 – Senior Research [10 credits]

Typical BA = 50 credits
Typical BS = 62 credits

Revisions to BS EEB: For the BS degree, the changes are the removal of CHEM 122 (+124), CHEM 211/212/215, PHYS 126, BIOC 301, an advanced lab, and a 300 level BIOC or EBIO course and the addition of a natural sciences or engineering course, EBIO 306, EBIO 334, and EBIO 4xx. Some of the removed and added requirements could be chosen to be the same (for instance by choosing BIOS 301 as the BIOC course or CHEM 122 or PHYS 126 as the natural sciences course)
EEB MAJOR TRACKS

These tracks within the Ecology and Evolutionary Biology majors serve to guide students in their choice of courses such that they are well prepared for further study or careers in different areas within ecology and evolutionary biology. No additional designation will appear on the diploma and students do not have to complete a track if they choose to design their own individualized course of study.

Conservation Biology / Environmental Biology Track

This track is appropriate for students interested in gaining in-depth training in the areas of Conservation Biology and Environmental Biology. For such students, useful courses include:

*EEB lecture courses*
- EBIO 323 - Conservation Biology
- EBIO 325 - Ecology
- EBIO 326 - Insect Biology
- EBIO 336 - Plant Diversity
- EBIO 340 - Global Biogeochemical Cycles

*EEB lab courses*
- EBIO 204 - Environmental Sustainability (Community Agriculture)
- EBIO 316 - Field Ecology Lab
- EBIO 327 - Biological Diversity Lab
- EBIO 330 - Insect Biology Lab
- EBIO 337 - Field Bird Biology Lab

*Non-EEB courses*
- CEVE 306 - Global Environmental Law
- CEVE 307 - Energy and the Environment
- ENGL 368 - Literature and the Environment
- ENST 312 - Environmental Battles in the 21st Century: Houston as Microcosm
- ENST 313 - Sustainable Design
- ENST 314 - Environmental Health
- ESCI 450 - Remote Sensing
- HIST 425 - US Conservation Movement
- SOCI 367 - Environmental Sociology

Evolutionary Biology Track

Students considering graduate work in evolutionary biology will typically need a full year of physics and a full year of chemistry, and sometimes organic chemistry or biochemistry. Statistics and computer skills are desirable. Other useful courses include:

*EEB lecture courses:*
- EBIO 321 - Animal Behavior
EBIO 326 - Insect Biology  
EBIO 328 - Evolution of Genes and Genomes  
EBIO 333 - Evolutionary Bioinformatics  
EBIO 334 - Evolution [required of all EEB majors]  
EBIO 336 - Plant Diversity  

**EEB labs:**  
EBIO 317 - Lab Module in Behavior  
EBIO 327 - Biological Diversity Lab  
EBIO 330 - Insect Biology Lab  
EBIO 337 - Field Biology Bird Lab  

**Other lecture courses:**  
BIOC 344 - Molecular Biology and Genetics  
COMP 571 - Bioinformatics: Sequence Analysis  
ECON 340 - Introduction to Game Theory  
ANTH 203 - Human Antiquity: An Introduction to Physical Anthropology and Prehistory  

**Evolutionary Genetics and Genomics track**

**Synopsis:** The Evolutionary Genetics and Genomics (EGG) Track is a model course of study that (i) satisfies the degree requirements for a BS in Ecology and Evolutionary Biology at Rice, and (ii) emphasizes the knowledge and skills most important for pursuing a successful career in bioinformatics, evolutionary genetics/genomics, medicine, and related fields.  

While the track overlaps with other courses of study at Rice (and elsewhere) in that it is designed to train students to apply a “genomic toolkit” of concepts, skills and techniques, including computational analyses and molecular lab techniques, our track is unique in its emphasis on evolutionary biology. For example, comparative genomics is a perspective adopted in bioinformatics to identify genomic regions that are conserved between distantly related species. By inference, such conserved genomic regions are thought to be of functional significance. In addition to such pattern-oriented and applied perspectives adopted in many bioinformatics programs, students who pursue the EGG Track will understand the processes leading to the evolution of genomic sequences (e.g. the relative roles of selection and genetic drift), and their relationship to important scientific problems in evolutionary biology.  

The track consists of a set of core courses, plus a list of suggested courses from which students can choose.  

**Core EGG EEB lecture courses:**  
EBIO 328 - Evolution of genes and genomes  
EBIO 333 - Evolutionary bioinformatics  
EBIO 334 - Evolution [required of all EEB majors]
Other Bioscience Courses of interest:

This set of courses has been compiled from a variety of course offerings at Rice to provide the students with the ability to broaden their knowledge in areas the post-genome era is beginning to leave its mark. Students are encouraged to choose courses from the following compilation.

BIOC 307 - Genetics: Science and society
EBIO 323 - Conservation biology
EBIO 321 - Behavior
EBIO 325 – Ecology
EBIO 326 – Insect biology
EBIO 336 – Plant diversity
ENST/ESCI 102 - Evolution of the earth
KINE 300 - Human anatomy
KINE 301 - Human physiology
PHIL 313 - Philosophy of science
HUMA 260 - Genomics and social transformation
STAT 305 - Introduction to statistics for biosciences (required)

Suggested for quantitative/computational focus: This set of courses is meant as guide to inform the choice of courses for students who are interested primarily in the applications of computational biology in evolutionary research. This will enable the choice of courses that will be pre-requisites (by other Departments) when opting for the quantitative/computational focus.

BIOC 533 Bioinformatics & computational biology
BIOE 391 - Numerical methods
COMP 100 - Introduction to computing and information systems
COMP 571 - Bioinformatics: Sequence analysis
COMP 572 - Bioinformatics: Network analysis
MATH 111/112 - Fundamental theorem calculus/calculus and its applications
MATH 212 - Multivariable calculus
STAT 100 - Data, models, and reality
STAT 423 - Probability in bioinformatics and genetics
STAT 453 - Biostatistics
STAT 670 - Statistical genetics

Suggested for molecular genetics focus: This set of courses is meant as guide to inform the choice of courses for students who are interested primarily in the molecular genetic and genomic techniques conducted in evolutionary research laboratories. This will enable the choice of courses that will be pre-requisites (by other Departments) when opting for the molecular genetics focus.

BIOC 344 - Molecular biology and genetics (required)
BIOC 301 – Biochemistry
BIOC 302 – Biochemistry
BIOC 443 - Development
STAT 675 - Gene expression and proteomics

Labs:
Students should acquire a basic understanding of organismal- and molecular biology, should be able to approach computational and mathematical problems from an applied perspective, and understand scientific publications where analytical and/or computational developments are presented.

We suggest that students need to take at least one intro lab course covering organisms and/or biological diversity (EEB), we require EBIO 333L, one introductory molecular biology lab (BCB), and one introductory lab in computational biology, computer science, statistics or applied mathematics (EBIO, COMP, STA, MATH, CAAM).

EEB lab courses in Biology:
Required for EEG - EBIO 333L Evolutionary bioinformatics lab
One lab that covers organismal biology and/or diversity (EBIO 316, EBIO 317, EBIO 337).

Non-EEB lab courses in Biology:
We suggest Lab Modules in Molecular Biology I and II or Lab in Cell and Developmental Biology
BIOC 311 and 312 - Advanced experimental biosciences and experimental molecular biology
BIOC 313 - Advanced Molecular Biology
BIOC 318 - Laboratory studies in applied microbiology

Non-EEB lab courses in computation, mathematics and statistics:
COMP 110 - Computation in science and engineering
CAAM 210 - Introduction to engineering computation (equivalent to COMP110)

Human Biology Track

This track is targeted towards students with an interest in human biology.

EEB lecture courses:
EBIO 328 - Evolution of Genes and Genomes
EBIO 329 - Animal Biology and Physiology
EBIO 331- Biology of Infectious Diseases
EBIO 333 - Evolutionary bioinformatics

EEB labs:
EBIO 333L - Bioinformatics Lab
EBIO 328L – Genomics Lab
EBIO 306 – Independent Research (conducted at Texas Medical Center)

non-EEB courses:
BIOC 344 - Molecular Biology and Genetics
BIOE 260 - Introduction To Global Health Issues
Minor in EEB

The Department of Ecology and Evolutionary Biology proposes the creation of a new departmental minor in EEB. We believe that this is an opportune time to begin this new minor with the proposed new BA in EEB, revising of the departmental codes, and revision to the BA BCB, BS BCB, and BS EEB all occurring for the 10/11 catalog.

The learning outcomes and associated structures of the proposed EEB departmental minor are:

1) *Breadth of knowledge in biology at the introductory level*
   Relevant curriculum features:
   - BIOC 201 / EBIO 202 (Introductory Biology)

2) *Technical and practical skills in ecology and evolutionary biology*
   Relevant curriculum features:
   - EBIO 213 - Introductory Lab in Ecology & Evolutionary Biology

3) *Knowledge of natural history*
   Relevant curriculum features
   - EBIO 213 (other labs)
   - Feature of majority of EEB courses [all but 333 and 338]

4) *Depth of knowledge of ecology and evolutionary biology*
   Relevant curriculum features
   - Four upper level EEB lecture courses

5) *Target audience*
   Students with a strong interest in organismal biology but are not able to take the large number of courses required of the EEB majors. We expect that this minor will be popular with students across the university.

**REQUIREMENTS FOR EEB MINOR**

*General Biology (6 credits):*
BIOC 201 / EBIO 202 - Introductory Biology I and II [6 cr]

*Biology Lab (1 credits):*
EBIO 213 - Introductory Lab in Ecology & Evolutionary Biology [1 cr]

*Advanced EEB courses (12 credits):*
Four EBIO lecture courses at 300 or 400 level [12 cr]

6 courses
19 credits
BCB Department Majors

The learning outcomes and associated structures of the proposed BIOC degrees are:

1) **Base of knowledge in physical and chemical sciences**
   Relevant curriculum features:
   - CHEM 121/122 – Introductory Chemistry (and lab)
   - CHEM 211/212/215 – Organic Chemistry (and lab)
   - PHYS 125/126 (or 101/102 or 111/112) – Introductory Physics (and lab)

2) **Strong quantitative skills**
   Relevant curriculum features:
   - MATH 101/102 – Introductory Calculus
   - MATH 211 or 213 – Ordinary Differential Equations
   - Two 300 or 400 courses in other Natural Sciences or in Engineering

3) **Technical and practical skills in biology**
   Relevant curriculum features:
   - BIOC 111/211 – Introductory Biology Lab
   - BIOC 311 – Advanced Experimental Biosciences
   - Two 300 or 400 Advanced BIOC Labs

4) **Core knowledge of biology, biochemistry and cell biology.**
   Relevant curriculum features:
   - BIOC 201 – Introductory Biology
   - BIOC 301 – Biochemistry I
   - BIOC 341 – Cell Biology

5) **In-depth knowledge of genetics, biochemistry, and physical chemistry**
   Relevant curriculum features:
   - BIOC 344 – Genetics
   - BIOC 302 – Biochemistry II
   - BIOC 352 – Physical Chemistry for the Biosciences

6) **Verbal and written communication skills**
   Relevant curriculum features:
   - BIOC 201 includes small group discussions with individual presentations and short writing assignments.
   - BIOC 300 and 400 Advanced Labs, BIOC 310 Independent Research, and BIOC 401/402 Senior Honors Research includes poster and slide verbal presentations in addition to research paper or thesis-style written assignments.
   - Component of all 400-level BIOC courses.

7) **Analytical thinking in biochemistry and cell biology**
   Relevant curriculum features
   - 400-level BIOC capstone courses emphasizing analysis of recent research
8) Problem solving and analytical thinking in Biochemistry and Cell Biology research through state-of-the-art independent lab research at Rice University or the nearby Texas Medical Center. Almost limitless opportunities for intensive undergraduate research experiences in BCB and related biosciences are coordinated through a vigorous program: https://owlspace-ccm.rice.edu/access/content/group/80681911-e349-4e12-80bc-94e62a2d8df4/Bios310_web/index.html

Relevant curriculum features:
BIOC 310 - Independent Research
HONS 470 – Rice Undergraduate Scholars Program
BIOC 401/402 - Senior Honors Research

9) The BS is distinguished from the BA by greater in-depth knowledge of and emphasis on research in Biochemistry and Cell Biology.

The BA is likely to be a degree for pre-professionals (pre-law, pre-med) or for students doubling the BCB major with a non-science degree. The BS provides a more rigorous preparation in Biochemistry and Cell Biology although opportunities for research training are the same for the BA and the BS. BCB BS students would enter the workforce with this as their terminal degree or would continue on to graduate school in a BCB related field.

10) Double-majors

The general biology degree serves a distinct purpose in terms of allowing students to balance their knowledge across the breadth of biology. It is likely that without this degree being retained that there would be no such option and students would have to choose a more narrow degree with a dept. As with the EEB BA, it will be easy to double the Biological Sciences BA with the BCB BA. We therefore propose that students not be allowed to combine the Biological Sciences BA with other BA degrees in the Biosciences.

11) Peer institutions

The proposed BCB degree programs were formulated in such a way as to keep Rice Biochemistry & Cell Biology in-line with similar programs at peer institutions, such as Columbia, Princeton, and Yale. Particular attention was paid to the total number of laboratory classes required for BS and BA degrees. For example, Yale’s degree requirements can be found here: http://www.biology.yale.edu/undergrad/undergrad_area_2.html.

12) General Announcements

See Appendix 2 for the GA information for EEB.
REQUIREMENTS FOR BA BCB

Non-biology courses (32 credits):
MATH 101/102 - Single Variable Calculus I and II [6 credits]
MATH 211 or 213 - Ordinary Differential Eqns [3 credits]
CHEM 121/122 (123/124) - General Chemistry with Laboratory [8 credits]
CHEM 211/212/215 - Organic Chemistry with Laboratory [8 credits]
PHYS 125/126 or PHYS 101/102 or PHYS 111/112 - General Physics I/II [7 credits]

General Biology (3 credits):
BIOC 201 - Introductory Biology I [3 credits]

Biology Labs (6 credits):
BIOC 211 - Introductory Experimental Biosciences [2 credits]
BIOC 311 - Adv Exp. Biosciences [2 credits]
Two 300, 400, or 500 level labs in BIOC [2 credits] (BIOC 313, BIOC 318, BIOC 320 (BIOE 342), BIOC 415, BIOC 530, BIOC 532, or BIOC 535)

Non-BIOC Course in Natural Sciences or Engineering at ≥300-lvl (6 credits):
Two 300 or 400 level lecture courses [6 credits]

Advanced BCB courses (15 credits):
BIOC 341 Cell Biology [3 credits]
BIOC 301 Biochemistry [3 credits]
Two of these three [6 credits]
    BIOC 344 Genetics, BIOC 302 Biochemistry II, BIOC 352 Physical Chemistry
One upper level capstone (400-lvl) BIOC course [≥ 3 credits]

23 Courses
Typical BA = 62 credits

Changes from Current B.A. in Biochemistry and Cell Biology:
EBIO 202, EBIO 213, and 300-level EBIO lecture course are no longer required; EBIO labs no longer count towards the major; only need 1 advanced BIOC lecture course instead of two; one fewer 300+ level BIOC course is required but 400-level BIOC capstone course is required; two advanced non-bio science or engineering lecture courses are required.
REQUIREMENTS FOR BS BCB

Non-biology courses (32 credits):
MATH 101/102 - Single Variable Calculus I and II [6 credits]
MATH 211 or 213 - Ordinary Differential Eqns [3 credits]
CHEM 121/122 (123/124) - General Chemistry with Laboratory [8 credits]
CHEM 211/212/215 - Organic Chemistry with Laboratory [8 credits]
PHYS 125/126 or PHYS 101/102 or PHYS 111/112 - General Physics I/II [7 credits]

General Biology (3 credits):
BIOC 201- Introductory Biology I [3 credits]

Biology Labs (6 credits):
BIOC 211 - Introductory Experimental Biosciences [2 credits]
BIOC 311- Adv Exp. Biosciences [2 credits]
Two 300, 400, or 500 level labs in BIOC [2 credits] (BIOC 313, BIOC 318, BIOC 320 (BIOE 342), BIOC 415, BIOC 530, BIOC 532, or BIOC 535)

Non-BIOC Course in Natural Sciences or Engineering at ≥300-lvl (6 credits):
Two 300 or 400 level lecture courses [6 credits]

Advanced BCB courses (21 credits):
BIOC 341 Cell Biology [3 credits]
BIOC 301 Biochemistry [3 credits]
BIOC 344 Genetics [3 credits]
BIOC 302 Biochemistry II [3 credits]
BIOC 352 Physical Chemistry [3 credits]
Two upper level capstone (400-lvl) BIOC course [≥ 3 credits]

26 Courses
Typical BS = 69 credits

Changes from Current B.S. in Biochemistry and Cell Biology:
EBIO 202, EBIO 213, and 300-level EBIO lecture course are no longer required; EBIO labs no longer count towards the major; two advanced non-bio science or engineering lecture courses are required; fewer BIOC 300+ courses required but two 400-level BIOC capstone courses are required.
Requirements for Minor in BCB

CHEM 121/122/123/124 – General Chemistry (with lab)
CHEM 211/212/215 – Organic Chemistry (with lab)
BIOC 201 – Introductory Biology I
BIOC 211 - Introductory Experimental Biosciences
BIOC 301 - Biochemistry
BIOC 341 – Cell Biology
One BIOC lecture course at the 300 or 400 level (>3cr hrs)

12 courses
30 credits
Requirements for BA in Biological Sciences

(unchanged other than BIOS designation changing to BIOC or EBIO)

Non-biology courses:
MATH 101/102 - Single Variable Calculus I and II [6 credits]
MATH 211, MATH 213, STAT 305, or EBIO 338 [3 or 4 credits]
CHEM 121/122/123/124 - General Chemistry with Laboratory [8 credits]
CHEM 211/212/215 - Organic Chemistry with Laboratory [8 credits]
PHYS 125/126 or PHYS 101/102 or PHYS 111/112 - General Physics I/II [7 credits]

General Biology:
BIOC 201 / EBIO 202 - Introductory Biology I and II [6 credits]

Biology Labs:
BIOC 211 - Introductory Experimental Biosciences [2 credits]
EBIO 213 - Introductory Lab in Ecology and Evolutionary Biology [1 credits]
Three 300 or 400 level labs in EBIO or BIOC [2 credits]

Upper level Biology courses:
BIOC 301 [3 credits]
Three EBIO 300 or 400 level lecture course [9 credits]
BIOC 300 or 400 level lecture course [3 credits]
BIOC 302, 341, 344, or 352 [3 credits]
BIOC or EBIO 300 or 400 level lecture course [3 credits]
Table 1 – Number of courses in different areas in biosciences degrees

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Appendix 1. General Announcements Information for Ecology and Evolutionary Biology

Ecology and Evolutionary Biology
The Wiess School of Natural Sciences

Chair
Evan Siemann

Professors
James S. Coleman
David C. Queller
Joan E. Strassmann
Calvin H. Ward

Assistant Professors
Amy Dunham
Nat Holland
Michael Kohn
Nicholas H. Putnam
Jennifer Rudgers
Volker Rudolf
Ken Whitney

Huxley Fellows
Lesley Cambell
Tom Miller

Professors Emeriti
Frank M. Fisher Jr
Paul A. Harcombe
Ronald L. Sass
Stephen Subtelny
Adjunct Faculty
Ricardo Azevedo
Blaine Cole
Tim Cooper
Yuriy Fofanov
Tony Frankino
Jeff Glassberg
Dan Graur
Nancy Greig
Adam Kuspa
Wen-Hsiung Li
Steve Pennings

Degrees Offered: minor, BA, BS, MA, PhD

Undergraduate Programs—The Department of Ecology and Evolutionary Biology offers a broad range of courses in the biosciences: animal behavior, animal biology, bioinformatics, conservation biology, diseases, ecology, evolutionary biology, field ecology, genetics, genomics, immunology, molecular biology, natural history, plant biology, and advanced courses in these and related areas. Students may elect a BA in biological sciences, BA in ecology and evolutionary biology, BS in ecology and evolutionary biology, or a departmental minor in ecology and evolutionary biology.

BA Biological Sciences

This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate or Professional school. Coursework is designed to emphasize a broad understanding of the
The full range of biological disciplines. The BA in Biological Sciences may not be combined with any other Biosciences degree (i.e. BA Biochemistry and Cell Biology, BA Ecology and Evolutionary Biology, BS Biochemistry and Cell Biology, BS Ecology and Evolutionary Biology, Minor in Biochemistry and Cell Biology, or Minor Ecology and Evolutionary Biology). This degree is jointly managed by the Department of Ecology and Evolutionary Biology and the Department of Biochemistry and Cell Biology.

**Non-biology courses:**
- MATH 101/102 Single Variable Calculus I and II
- MATH 211, MATH 213, STAT 305, or EBIO 338 Differential Equations or Biological Statistics course
- CHEM 121/122/123/124 General Chemistry with Laboratory
- CHEM 211/212/215 Organic Chemistry with Laboratory
- PHYS 125/126 General Physics I/II

**Introductory Biology:**
- BIOC 201 / EBIO 202 Introductory Biology I and II

**Introductory Biology Labs:**
- BIOC 211 Introductory Experimental Biosciences
- EBIO 213 Introductory Lab in Ecology and Evolutionary Biology

**Advanced Biology Labs:**
- Three Biology labs from the following list:
  - BIOC 311 Advanced Experimental Biosciences
  - BIOC 313 Introductory Synthetic Biology
  - BIOC 318 Lab in Applied Microbiology
  - BIOC 320/BIOE 342 Lab in Tissue Culture
  - BIOC 413 Experimental Molecular Biology
  - BIOC 415 Experimental Physiology
  - BIOC 530 NMR Spectroscopy and Molecular Modeling
  - BIOC 532 Lab in Optical Spectroscopy and Kinetics
  - BIOC 533 Bioinformatics and Computational Biology
  - BIOC 535 Practical X-Ray Crystallography
  - EBIO 316 Lab in Ecology
  - EBIO 317 Lab in Behavior
  - EBIO 327 Biological Diversity Lab
  - EBIO 330 Insect Biology Lab
  - EBIO 337 Field Bird Biology Lab
  - EBIO 393 Laboratory Transfer Credit in Biosciences

**Upper level Biology courses:**
- BIOC 301 Biochemistry
- Three EBIO 300 or 400 level lecture courses
- One BIOC 300 or 400 level lecture course
- BIOC 302, 341, 344, or 352
One BIOC or EBIO 300 or 400 level lecture course

MATH 111 and 112 may be substituted for MATH 101; CHEM 151 and 152 may be substituted for CHEM 121 and 122; CHEM 251 and 252 may be substituted for CHEM 211 and 212; PHYS 101 and 102 or PHYS 111 and 112 and their labs may be substituted for PHYS 125 and 126.

One of the advanced laboratory course requirements can be satisfied by taking any of the following: (i) BIOS 310 or BIOS 306 if taken for at least two credits; or (ii) HONS 470/471, if the research supervisor is from one of the biosciences departments or if the research is biological in nature and preapproved by the student’s advisor; (iii) BIOS 412; or (iv) BIOS 393.

**BA Ecology and Evolutionary Biology**

This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate or Professional school. This degree is well suited for students with an additional major that is not in the sciences. Coursework is designed to emphasize a broad understanding of basic biology together with an in-depth knowledge of ecology and evolutionary biology that culminates in a required capstone 400-level course that incorporates primary scientific literature, presentations and writing in a advanced topic. Students are strongly encouraged to take advantage of study abroad opportunities.

**Non-biology courses:**
MATH 101/102 *Single Variable Calculus I and II*
STAT course or EBIO 338 *Design and Analysis of Biological Experiments*
CHEM 121/123 *General Chemistry with Laboratory*
PHYS 125 *General Physics I*
One natural sciences or engineering course at the 300 level or above

**Introductory Biology:**
BIOC 201 / EBIO 202 *Introductory Biology I and II*

**Biology Labs:**
BIOC 211 *Introductory Experimental Biosciences*
EBIO 213 *Introductory Lab in Ecology and Evolutionary Biology*
Two 300 or 400 level labs in EBIO or BIOC

**Non-EEB Biology course:**
300 or 400 level BIOC lecture course

**Advanced EEB courses:**
EBIO 334 *Evolution*
Three EBIO lecture courses at 300 or 400 level [12 credits]
SR scientific communication course:
EBIO 4xx Scientific Communication in the Biosciences

BS Ecology and Evolutionary Biology

This degree path is intended for students pursuing a wide range of careers in the life sciences with required research in organismal biology. Students graduating from this degree path typically go on to Graduate or Professional school or enter the workforce with this as their terminal degree. Coursework is designed to emphasize a broad understanding of basic biology together with an in-depth knowledge of ecology and evolutionary biology that culminates in a required capstone 400-level course that incorporates primary scientific literature, presentations and writing in a advanced topic. Additionally students in this degree program are required to conduct independent research under the supervision or co-supervision of an EEB faculty member (though the research can take place in other locations or institutions such as the Texas Medical Center or at field sites throughout the world). Students are strongly encouraged to take advantage of study abroad opportunities.

In addition to the requirements for the BA in Ecology and Evolutionary Biology, the BS requires the following courses:

EBIO 306 Independent Research [for at least 2 credits]
EBIO 403/404 Senior Research

MINOR Ecology and Evolutionary Biology

The EEB minor is intended for the large number of students with an avid interest in ecology and evolutionary biology but whose major interests are in other departments.

Introductory Biology:
BIOC 201 / EBIO 202 Introductory Biology I and II

Biology Lab:
EBIO 213 - Introductory Lab in Ecology & Evolutionary Biology [1 cr]

Advanced EEB lecture courses:
Four EBIO lecture courses at the 300 or 400 level

EEB MAJOR TRACKS

These tracks within the Ecology and Evolutionary Biology majors serve to guide students in their choice of courses such that they are well prepared for further study or careers in different areas within ecology and evolutionary biology. No additional designation will
appear on the diploma and students do not have to complete a track if they choose to design their own individualized course of study.

CONSERVATION BIOLOGY / ENVIRONMENTAL BIOLOGY TRACK

This track is appropriate for students interested in gaining in-depth training in the areas of Conservation Biology and Environmental Biology. For such students, useful courses include:

**EEB lecture courses:**
- EBIO 323 Conservation Biology
- EBIO 325 Ecology
- EBIO 326 Insect Biology
- EBIO 336 Plant Diversity
- EBIO 340 Global Biogeochemical Cycles

**EEB lab courses:**
- EBIO 204 Environmental Sustainability (Community Agriculture)
- EBIO 316 Field Ecology Lab
- EBIO 327 Biological Diversity Lab
- EBIO 330 Insect Biology Lab
- EBIO 337 Field Bird Biology Lab

**Non-EEB courses:**
- CEVE 306 Global Environmental Law
- CEVE 307 Energy and the Environment
- ENGL 368 Literature and the Environment
- ENST 312 Environmental Battles in the 21st Century: Houston as Microcosm
- ENST 313 Sustainable Design
- ENST 314 Environmental Health
- ESCI 450 Remote Sensing
- HIST 425 US Conservation Movement
- SOCI 367 Environmental Sociology

EVOLUTIONARY BIOLOGY TRACK

Students considering graduate work in evolutionary biology will typically need a full year of physics and a full year of chemistry, and sometimes organic chemistry or biochemistry. Statistics and computer skills are desirable. Other useful courses include:

**EEB lecture courses:**
- EBIO 321 Animal Behavior
- EBIO 326 Insect Biology
- EBIO 328 Evolution of Genes and Genomes
- EBIO 333 Evolutionary Bioinformatics
EBIO 334 *Evolution* [required of all EEB majors]
EBIO 336 *Plant Diversity*

**EEB labs:**
EBIO 317 *Lab Module in Behavior*
EBIO 327 *Biological Diversity Lab*
EBIO 330 *Insect Biology Lab*
EBIO 337 *Field Biology Bird Lab*

**Other lecture courses:**
BIOC 344 *Molecular Biology and Genetics*
COMP 571 *Bioinformatics: Sequence Analysis*
ECON 340 *Introduction to Game Theory*
ANTH 203 *Human Antiquity: An Introduction to Physical Anthropology and Prehistory*

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**EVOLUTIONARY GENETICS AND GENOMICS TRACK**

**Synopsis:** The Evolutionary Genetics and Genomics (EGG) Track is a model course of study that (i) satisfies the degree requirements for a BS in Ecology and Evolutionary Biology at Rice, and (ii) emphasizes the knowledge and skills most important for pursuing a successful career in bioinformatics, evolutionary genetics/genomics, medicine, and related fields.

While the track overlaps with other courses of study at Rice (and elsewhere) in that it is designed to train students to apply a “genomic toolkit” of concepts, skills and techniques, including computational analyses and molecular lab techniques, our track is unique in its emphasis on evolutionary biology. For example, comparative genomics is a perspective adopted in bioinformatics to identify genomic regions that are conserved between distantly related species. By inference, such conserved genomic regions are thought to be of functional significance. In addition to such pattern-oriented and applied perspectives adopted in many bioinformatics programs, students who pursue the EGG Track will understand the processes leading to the evolution of genomic sequences (*e.g.* the relative roles of selection and genetic drift), and their relationship to important scientific problems in evolutionary biology.

The track consists of a set of core courses, plus a list of suggested courses from which students can choose.

**Core EGG EEB lecture courses:**
EBIO 328 *Evolution of genes and genomes*
EBIO 333 *Evolutionary bioinformatics*
EBIO 334 *Evolution* [required of all EEB majors]

**Other Bioscience Courses of interest:**
This set of courses has been compiled from a variety of course offerings at Rice to provide the students with the ability to broaden their knowledge in areas the post-genome
era is beginning to leave its mark. Students are encouraged to choose courses from the following compilation.

BIOC 307 *Genetics: Science and society*
EBIO 323 *Conservation biology*
EBIO 321 *Behavior*
EBIO 325 *Ecology*
EBIO 326 *Insect biology*
EBIO 336 *Plant diversity*
ENST/ESCI 102 *Evolution of the earth*
KINE 300 *Human anatomy*
KINE 301 *Human physiology*
PHIL 313 *Philosophy of science*
HUMA 260 *Genomics and social transformation*
STAT 305 *Introduction to statistics for biosciences* (required)

Suggested for quantitative/computational focus: This set of courses is meant as guide to inform the choice of courses for students who are interested primarily in the applications of computational biology in evolutionary research. This will enable the choice of courses that will be pre-requisites (by other Departments) when opting for the quantitative/computational focus.

BIOC 533 *Bioinformatics & computational biology*
BIOE 391 *Numerical methods*
COMP 100 *Introduction to computing and information systems*
COMP 571 *Bioinformatics: Sequence analysis*
COMP 572 *Bioinformatics: Network analysis*
MATH 111/112 *Fundamental theorem calculus/calculus and its applications*
MATH 212 *Multivariable calculus*
STAT 100 *Data, models, and reality*
STAT 423 *Probability in bioinformatics and genetics*
STAT 453 *Biostatistics*
STAT 670 *Statistical genetics*

Suggested for molecular genetics focus: This set of courses is meant as guide to inform the choice of courses for students who are interested primarily in the molecular genetic and genomic techniques conducted in evolutionary research laboratories. This will enable the choice of courses that will be pre-requisites (by other Departments) when opting for the molecular genetics focus.

BIOC 344 *Molecular biology and genetics* (required)
BIOC 301 *Biochemistry*
BIOC 302 *Biochemistry*
BIOC 443 *Development*
STAT 675 *Gene expression and proteomics*
**Labs:**
Students should acquire a basic understanding of organismal- and molecular biology, should be able to approach computational and mathematical problems from an applied perspective, and understand scientific publications where analytical and/or computational developments are presented.

We suggest that students need to take at least one intro lab course covering organisms and/or biological diversity (EEB), we require EBIO 333L, one introductory molecular biology lab (BCB), and one introductory lab in computational biology, computer science, statistics or applied mathematics (EBIO, COMP, STA, MATH, CAAM).

**EEB lab courses in Biology:**
Required for EEG - EBIO 333L *Evolutionary bioinformatics lab*
One lab that covers organismal biology and/or diversity (EBIO 316, EBIO 317, EBIO 337).

**Non-EEB lab courses in Biology:**
We suggest Lab Modules in Molecular Biology I and II or Lab in Cell and Developmental Biology
BIOC 311 and 312 *Advanced experimental biosciences and experimental molecular biology*
BIOC 313 *Advanced Molecular Biology*
BIOC 318 *Laboratory studies in applied microbiology*

**Non-EEB lab courses in computation, mathematics and statistics:**
COMP 110 *Computation in science and engineering*
CAAM 210 *Introduction to engineering computation* (equivalent to COMP110)
HUMAN BIOLOGY TRACK

This track is targeted towards students with an interest in human biology.

EEB lecture courses:
EBIO 328 Evolution of Genes and Genomes
EBIO 329 Animal Biology and Physiology
EBIO 331 Biology of Infectious Diseases
EBIO 333 Evolutionary bioinformatics

EEB labs:
EBIO 333L Bioinformatics Lab
EBIO 328L Genomics Lab
EBIO 306 Independent Research (conducted at Texas Medical Center)

non-EEB courses:
BIOC 344 Molecular Biology and Genetics
BIOE 260 Introduction To Global Health Issues
BIOE 320 Systems Physiology Lab Module
BIOE 362 Bioengineering For Global Health Environment

ADVISING

Students pursuing an EEB degree (BA, BS or minor) should contact the EEB departmental office to be assigned to an advisor. Those electing a BA in biological sciences may choose the department (BCB or EEB) that most closely corresponds to their interests, and that choice may be changed at any time.

GRADUATE DEGREES

Degree Requirements For MS, MA, and PhD in Ecology and Evolutionary Biology

Admission—Applicants for graduate study in the Department of Ecology and Evolutionary Biology must have:

• BA or BS degree or equivalent that provides a strong background in biology
• Strong ability and motivation, as indicated by academic record, Graduate Record Examination (GRE) scores, and recommendations
• Scores from the GRE Biology subject exam are optional but can be helpful, particularly for student with nontraditional backgrounds in biology

These requirements do not preclude admission of qualified applicants who have majored in areas other than biology. Although the department offers MA and MS degrees, only on rare occasions are students who do not intend to pursue the PhD admitted to the graduate program.
Students should have completed course work in physics, mathematics (including calculus), and chemistry (including organic chemistry) prior to admission. Deficiencies in these subject areas or in specific areas of biology should be made up during the first year of residence; some may be waived at the discretion of the student's advisory committee and the department chair.

Entering students will meet with a faculty advisor to form a course of study of the first year. All first year students will complete the core course in ecology and evolutionary biology (BIOS 569) in their first semester. All graduate students are required to complete BIOS 585/586 (Graduate Seminar in Ecology and Evolutionary Biology) and two semesters of BIOS 591 (Graduate Teaching). Students must maintain a grade average of B in courses taken in the department and satisfactory grades in courses taken outside the department.

Students must demonstrate satisfactory progress in their degree program in annual reviews by a departmental committee. The review process requires that each student present a public seminar on their research, prepare a written report on their progress, and participate in an interview with the departmental committee. For general university requirements, see Graduate Degrees (in General Announcements).

**MS Program.** In addition to the general university requirements and those listed above, the master of science in ecology and evolutionary biology requires at least 10 hours of research credit.

**MA Program.** In addition to the general university requirements and those listed above, the master of arts in ecology and evolutionary biology requires the completion and public defense of a thesis embodying the results of an original investigation.

**PhD Program.** In addition to the general university requirements and those listed above, the PhD degree in ecology and evolutionary biology requires:

- Passing the admission to candidacy examination given by the Graduate Thesis Committee. (Committee will be composed of at least four members. At least three must be members of the EEB graduate faculty.)
- Complete an original investigation and a doctoral thesis with the potential to produce publications in reputable, peer-reviewed scientific journals
- Present a departmental seminar on the research
- Publicly defend the doctoral thesis
Appendix 1. General Announcements Information for Biochemistry and Cell Biology

Biochemistry and Cell Biology
The Wiess School of Natural Sciences

Chair
Janet Braam

Distinguished Faculty Fellow
Quentin Gibson

Professors
Bonnie Bartel
Kathleen Beckingham
George N. Bennett
Daniel D. Carson
Mary C. Farach-Carson
Michael C. Gustin
Seiichi P. T. Matsuda
Kathleen Shive Matthews
John S. Olson
Ronald J. Parry
Michael Stern
Charles R. Stewart

Senior Faculty Fellow
Marian Fabian

Faculty Fellows
Daniel Harrington
Darrell Pilling

Professors Emeriti
James Wayne Campbell
Raymon M. Glantz
Jordan Konisky
Graham Palmer
James B. Walker

Lecturer/Laboratory Coordinators
Beth Beason Abmayr
David R. Caprette
Elizabeth Eich
Alma Novotny
Dereth Phillips

Professors Emeriti
James A. McNew
Edward P. Nikonowicz
Yousif Shamoo

Adjunct Faculty
Richard Behringer
Sarah Bondos
Richard Brennan
Richard Dixon
Daniel Feeback
Robert O. Fox
Richard Gomer
Vincent Hilser
Kendal Hirschi
Mary Ellen Lane
Olivier Lichtarge
Kevin R. MacKenzie
Paolo Moretti
Timothy Palzkill
Debananda Pati
Neal Pellis
Florante A. Quiocio
Clarence Sams
Shelley Sazer
Ah-Lim Tsai
Peggy Whitson
Pernilla Wittung-Stafshede

Assistant Professors
Matthew Bennett
Michael Covington
Peter Lwigale
Luay K. Nakhleh
Laura Segatori
Jonathan Silberg
Yizhi Jane Tao
Daniel Wagner
Weiwei Zhong

Associate Professors
James A. McNew
Edward P. Nikonowicz
Yousif Shamoo

Lecturer/Laboratory Coordinators
Beth Beason Abmayr
David R. Caprette
Elizabeth Eich
Alma Novotny
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Kevin R. MacKenzie
Paolo Moretti
Timothy Palzkill
Debananda Pati
Neal Pellis
Florante A. Quiocio
Clarence Sams
Shelley Sazer
Ah-Lim Tsai
Peggy Whitson
Pernilla Wittung-Stafshede
DEGREES OFFERED: BA, BS, PHD

Undergraduate Programs—The Department of Biochemistry and Cell Biology offers a broad range of courses in the biosciences: biochemistry, biophysics, cell biology, developmental biology, endocrinology, genetics, immunology, microbiology, molecular biology, neurobiology, plant biology, and advanced courses in these and related areas. Students may elect a BA in Biochemistry and Cell Biology, BA in Biological Sciences, or a BS in Biochemistry and Cell Biology. They also may select courses from the range of topics listed above.

Course requirements for each degree path.

BA Biochemistry & Cell Biology

BA Biochemistry and Cell Biology - This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate, Medical or other professional school. Coursework is designed to emphasize a broad understanding of cell biology and biochemistry that culminates in a required capstone 400-level course that incorporates primary scientific literature, presentations and writing in an advanced topic.

MATH 101/102 Single Variable Calculus I and II

MATH 211 Ordinary Differential Equations and Linear Algebra
or
MATH 213 Basic Mathematical Biology

PHYS 101/102 Mechanics and Electricity & Magnetism (with their labs)
or
PHYS 125/126 General Physics I and II (with their labs)
or
PHYS 111/112 Mechanics and Electricity & Magnetism (with their labs)

CHEM 121/122/124 General Chemistry with Laboratory
CHEM 211/212/215 Organic Chemistry with Laboratory

BIOC 201 Introductory Biology
BIOC 211 Introductory Experimental Biosciences
BIOC 301 Biochemistry
BIOC 341 Cell Biology

2 of these 3 Courses:
BIOC 302 Biochemistry
BIOC 344 Molecular Biology and Genetics
BIOC 352 Physical Chemistry for the Biosciences
BIOC 311 Advanced Experimental Biosciences
plus two Advanced Labs*
  BIOC 313 Introductory Synthetic Biology
  BIOC 318 Lab in Applied Microbiology
  BIOC 320/BIOE 342 Lab in Tissue Culture
  BIOC 413 Experimental Molecular Biology
  BIOC 415 Experimental Physiology
  BIOC 530 NMR Spectroscopy and Molecular Modeling
  BIOC 532 Lab in Optical Spectroscopy and Kinetics
  BIOC 533 Bioinformatics and Computational Biology
  BIOC 535 Practical X-Ray Crystallography

1 BIOC 400 level ** (≥3cr hrs)

2 Natural Sciences or Engineering*** ≥300 level (≥3cr hrs)

* BIOC 310 OR HONS 471/472 may be used to substitute for 1 Advanced Lab.
** BIOC 401/402/412 is considered a single BIOC 400 level course and an Advanced Lab
*** Natural Sciences/Engineering includes any 300 or greater level course of at least 3 credit hours from a department of the Wiess School of Natural Sciences or George R. Brown School of Engineering.

CHEM 310 or CHEM 311 and 312 may be substituted for BIOC 352. Students may receive credit toward the major for a maximum of three credits of BIOC 390.

BS Biochemistry & Cell Biology

This degree path is intended for students pursuing a wide range of careers in the life sciences with an emphasis on research. Students graduating from this degree path typically go on to Graduate, Medical or other professional school. Coursework is designed to build a deeper understanding of cell biology and biochemistry through additional upper level coursework in topics that can include biochemistry, biophysics, cell biology, genetics and developmental biology. The BS culminates in two required capstone 400-level courses that incorporate primary scientific literature, presentations and writing in advanced topics. Additionally students in this degree program are strongly encouraged to pursue their research interests.

MATH 101/102 Single Variable Calculus I and II

MATH 211 Ordinary Differential Equations and Linear Algebra
or
MATH 213 Basic Mathematical Biology

PHYS 101/102 Mechanics and Electricity & Magnetism (with their labs)
or
PHYS 125/126 General Physics I and II (with their labs)
or
PHYS 111/112 Mechanics and Electricity & Magnetism (with their labs)

CHEM 121/122/123/124 General Chemistry with Laboratory
CHEM 211/212/215 Organic Chemistry with Laboratory

BIOC 201 Introductory Biology
BIOC 211 Introductory Experimental Biosciences
BIOC 301 Biochemistry
BIOC 302 Biochemistry
BIOC 341 Cell Biology
BIOC 344 Molecular Biology and Genetics
BIOC 352 Physical Chemistry for the Biosciences

BIOC 311 Advanced Experimental Biosciences
plus two Advanced Labs*
   BIOC 313 Introductory Synthetic Biology
   BIOC 318 Lab in Applied Microbiology
   BIOC 320/BIOE 342 Lab in Tissue Culture
   BIOC 413 Experimental Molecular Biology
   BIOC 415 Experimental Physiology
   BIOC 530 NMR Spectroscopy and Molecular Modeling
   BIOC 532 Lab in Optical Spectroscopy and Kinetics
   BIOC 533 Bioinformatics and Computational Biology
   BIOC 535 Practical X-Ray Crystallography

2 BIOC 400 level ** (≥3 cr hrs per course)

2 Natural Sciences or Engineering ≥300 level (≥3 cr hrs)**

* BIOC 310 OR HONS 471/472 may be used to substitute for 1 Advanced Lab.
** BIOC 401/402/412 is considered a single BIOC 400 level course and an Advanced Lab
*** Natural Sciences/Engineering includes any 300 or greater level course of at least 3 credit hours from a department of the Wiess School of Natural Sciences or George R. Brown School of Engineering.

CHEM 310 or CHEM 311 and 312 may be substituted for BIOC 352. Students may receive credit toward the major for a maximum of three credits of BIOC 390.

**BA Biological Sciences**

This degree path is intended for students pursuing a wide range of careers in the life sciences. Students graduating from this degree path typically go on to Graduate or
Professional school. Coursework is designed to emphasize a broad understanding of the full range of biological disciplines. The BA in Biological Sciences may not be combined with any other Biosciences degree (i.e. BA Biochemistry and Cell Biology, BA Ecology and Evolutionary Biology, BS Biochemistry and Cell Biology, BS Ecology and Evolutionary Biology, Minor in Biochemistry and Cell Biology, or Minor Ecology and Evolutionary Biology). This degree is jointly managed by the Department of Ecology and Evolutionary Biology and the Department of Biochemistry and Cell Biology.

**Non-biology courses:**
MATH 101/102 *Single Variable Calculus I and II*
MATH 211, MATH 213, STAT 305, or EBIO 338 *Differential Equations or Biological Statistics course*
CHEM 121/122/123/124 *General Chemistry with Laboratory*
CHEM 211/212/215 *Organic Chemistry with Laboratory*
PHYS 125/126 *General Physics I/II*

**Introductory Biology:**
BIOC 201 / EBIO 202 *Introductory Biology I and II*

**Introductory Biology Labs:**
BIOC 211 *Introductory Experimental Biosciences*
EBIO 213 *Introductory Lab in Ecology and Evolutionary Biology*

**Advanced Biology Labs:**
Three Biology labs from the following list:
BIOC 311 *Advanced Experimental Biosciences*
BIOC 313 *Introductory Synthetic Biology*
BIOC 318 *Lab in Applied Microbiology*
BIOC 320/BIOE 342 *Lab in Tissue Culture*
BIOC 413 *Experimental Molecular Biology*
BIOC 415 *Experimental Physiology*
BIOC 530 *NMR Spectroscopy and Molecular Modeling*
BIOC 532 *Lab in Optical Spectroscopy and Kinetics*
BIOC 533 *Bioinformatics and Computational Biology*
BIOC 535 *Practical X-Ray Crystallography*
EBIO 316 *Lab in Ecology*
EBIO 317 *Lab in Behavior*
EBIO 327 *Biological Diversity Lab*
EBIO 330 *Insect Biology Lab*
EBIO 337 *Field Bird Biology Lab*
EBIO 393 *Laboratory Transfer Credit in Biosciences*

**Upper level Biology courses:**
BIOC 301 *Biochemistry*
Three EBIO 300 or 400 level lecture courses
One BIOC 300 or 400 level lecture course  
BIOC 302, 341, 344, or 352
One BIOC or EBIO 300 or 400 level lecture course

MATH 111 and 112 may be substituted for MATH 101; CHEM 151 and 152 may be substituted for CHEM 121 and 122; CHEM 251 and 252 may be substituted for CHEM 211 and 212; PHYS 101 and 102 or PHYS 111 and 112 and their labs may be substituted for PHYS 125 and 126.

One of the advanced laboratory course requirements can be satisfied by taking any of the following: (i) BIOS 310 or BIOS 306 if taken for at least two credits; or (ii) HONS 470/471, if the research supervisor is from one of the biosciences departments or if the research is biological in nature and preapproved by the student’s advisor; (iii) BIOS 412; or (iv) BIOS 393.

Minor in Biochemistry & Cell Biology

The Biochemistry and Cell Biology minor is intended for students with an interest in the life sciences but are majoring in other areas. The Biochemistry and Cell Biology minor incorporates many of the life science core requirements required for the health professions. The minor may be combined with any major outside the Department of Biochemistry and Cell Biology

MATH 101/102 *Single Variable Calculus I and II*

PHYS 101/102 *Mechanics and Electricity & Magnetism* (with their labs)  
or  
PHYS 125/126 *General Physics I and II* (lab?)  
or  
PHYS 111/112 *Mechanics and Electricity & Magnetism* (with their labs)

CHEM 121/122/123/124 *General Chemistry with Laboratory*  
CHEM 211/212/215 *Organic Chemistry with Laboratory*

BIOC 201 *Introductory Biology*  
BIOC 211 *Introductory Experimental Biosciences*  
BIOC 301 *Biochemistry*  
BIOC 341 *Cell Biology*

1 BIOC ≥300 level **(≥3cr hrs)**