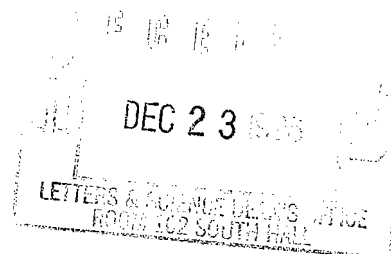


IOLOGY CORE CURRICULUM PROGRAM  
**Biocore**

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December 20, 1996

To Phillip Certain, Dean, College of Letters and Science  
From: Ann Burgess, Director *Ann*  
Re: Assessment Plan for Biocore

Our assessment plan is attached. Please contact me if you have any questions or suggestions concerning this.

c: Alex Nagel, Associate Dean

# **Biology Core Curriculum Assessment Plan**

December, 1996

## **Introduction**

The Biology Core Curriculum (Biocore) is a four semester interdepartmental honors program that provides students with a broad background in biology and prepares them for graduate or professional school in diverse fields of biological science. Biocore is not a major but fulfills some or all of the biology requirements for a variety of majors in the College of Letters and Science, the College of Agriculture and Life Sciences, and the School of Education. The program consists of four lecture/lab combinations intended to be taken in sequence: Evolution, Ecology, and Genetics (301/302); Cellular Biology (303/304); Organismal Biology (323/324); and Biological Interactions (333). A more complete description of the program is included as Appendix 1.

Members of Biology Core Curriculum Committee (the inter-college faculty committee that oversees Biocore), all faculty and staff who teach in the program, and some interested students were invited to a meeting on July 19, 1996 to discuss the goals of the program. The group clustered the most important skills and knowledge that we want Biocore students to acquire under the six headings described below. They delegated the task of developing a plan for assessing these goals to the Course Chairs' Committee: Evelyn Howell (301), Ann Burgess (302 and 304), Wayne Becker (303), Donata Oertel (323), Marcie Myers (324), and Lynn Allen-Hoffmann (333). Their plan is summarized on pages 2-3 and will be discussed at the next meeting of the Biology Core Curriculum Committee (February, 1997) and adopted or modified.

The course teams will use the information learned through this process to improve the program and the assessment methods.

## **Biocore's Goals**

### **Overarching goal:**

Students should be able to plan, conduct, and analyze an experiment to answer a question.

### **1. Critical thinking**

Students should be able to critically evaluate what they read or hear, applying a healthy skepticism and realizing the tentative nature of "facts." They should be able to recognize what they do not know, to use logic, to think creatively about science, and to use their knowledge to make decisions about their lives.

### **2. Quantitative reasoning**

Students should be able to think quantitatively about biological problems and to understand such fundamentals as scales and rates. They should be able to use the fundamentals of statistics (*e.g.*, mean, variance) in analyzing data.

### **3. Communication skills**

Students should be able to write clearly and concisely and to present and support an argument.

### **4. Acquiring information**

Students should be able to take effective notes during lectures, to make careful observations and generalize to see patterns, to find information in the library, to design an experiment to answer a question, and to experience the process of discovery.

## 5. Biological content

Students should appreciate the history of biological ideas and should acquire sufficient knowledge of biological principles and processes to handle advanced courses and exams like the MCAT and GRE. The group identified the following as essential content areas: evolution by natural selection, diversity of life, ecology, energy metabolism, molecular and transmission genetics, developmental biology, and human anatomy, physiology, reproduction, and nutrition.

## 6. Integration

Students should be able to integrate across different levels of organization (*e.g.*, cell to organism to ecosystem), to make connections with other disciplines (*e.g.*, chemistry, physics), and to connect biology with their own lives.

## Methods for Assessment

Our plan for beginning to evaluate the program focuses on three methods: surveying alumni who completed the program six years ago, imbedding a comprehensive integrative question into the final exam for the last course, and conducting an in-depth evaluation of one course. We intend to pursue additional activities in future years after we learn from these.

### 1. Alumni survey

We will contact students who completed the Biocore Program six years ago (most will have graduated five years ago) and ask them to fill out a survey asking how well Biocore prepared them for the courses that followed and for their present career. (This idea fits very well into our plan to maintain contact with our alumni through our newsletter, the *Biocourier*, and our World Wide Web site.) We will ask them to tell us what, if anything, was missing and also to comment on aspects of the program that turned out to be particularly valuable.

### 2. Comprehensive integrative question for the final exam

Biological Interactions is the final semester of the four semester sequence and is intended to give students a chance to build on and integrate the material they have learned in the previous three semesters by applying it to some current areas of active research. We will assess students' ability to integrate and apply biological knowledge by including a real or simulated analysis problem on the final exam. (We have included such a question from the 1996 exam in Appendix 2.)

### 3. Evaluation of Biocore 324: Organismal Biology Laboratory

We have planned a significant revision for Biocore 324 for fall, 1997 and will focus our first year assessment activities on this course. The revised course has 3 hours of laboratory and one 50 minute discussion section each week. Students learn plant and animal physiology by collaborating on experiments, in many cases using themselves as subjects (*e.g.*, electrocardiograms, electromyograms, respiration rates).

While we believe the experimental approach of the course helps students learn *content* -- reinforcing and enhancing the physiological concepts and facts that they are exposed to in the lecture portion of the class -- an important additional objective all of Biocore lab courses is to give students guided experiences in the *process* of science. In particular, the courses are designed to emphasize:

- the problem-solving involved in designing and executing experiments
- the critical thinking required to carefully analyze and interpret results to draw appropriate conclusions and synthesize them into a personal construct so that students can generate other questions to explore
- the importance of concisely and precisely communicating findings to others.

To evaluate how well the course achieves the *process* objective, we will compare each student's ability to analyze and interpret a novel set of physiological data at the beginning of the semester with their ability to analyze and interpret an equivalent set of data at the end of the semester. To do this we will create two sets of physiological data (Set A and Set B) that are equally challenging to analyze and interpret, randomly assign each student to analyze Set A or Set B at the beginning of the semester, and then have each student analyze the alternative set of data at the end of the semester. Kathleen Daniels, a biostatistician in the Preventative Medicine Department who is not otherwise involved with the course, will evaluate and score all analyses at the end of the semester (blinded to student identity and whether the analysis was from the beginning or end of the semester) and determine whether the ability of students to analyze and interpret experimental data significantly improved over the semester. Because a paired design removes variation due to differences in ability between students, use of this design will increase our power to find a beginning-end difference, if such exists, for individual students.

The results of this evaluation will allow us to assess the ability of Biocore 324 students to analyze and interpret data as well as whether their ability to do so was significantly enhanced after participating in the new version of the course.

### **Timetable for Implementation**

We anticipate that we will be able to carry out the assessment activities described above during the 1997 calendar year.



## Appendix 1: Biology Core Curriculum, 1996-97

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*Please note: Students wishing to enroll in the Biocore Program must apply for admission at the beginning of the preceding spring semester. For most students, this means applying in late January of their freshman year. Prerequisites are Math 221 (first semester calculus); Chem 104, 110, or 116 (second semester freshman chemistry); and concurrent (fall) registration in Chem 343 (organic chemistry). Pick up an application from the Biocore Office between January 20 and February 15 and submit it to the Biocore Admissions Committee (345 Noland Hall) by February 15. The Admissions Committee will notify those admitted by mid-March. Call the Biocore Office for further information.*  
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The Biology Core Curriculum (Biocore) is a four semester introductory honors sequence designed for undergraduates who are planning to go on to graduate or professional school in some field of biological science. It is also an appropriate course sequence for those intending to teach high school biology and for students who are not planning to major in a biological science but desire a more extensive introduction to biology than a one or two semester course can provide. Biocore is not a major but fulfills some or all of the biology requirements for a variety of biological science majors, including many in the College of Agricultural and Life Sciences as well as those in the College of Letters and Science.

The strength of the Biocore program derives partly from the participation in each course of faculty from different departments with a variety of viewpoints and special interests, and partly from the fact that the whole spectrum of living organisms is used to gain an understanding of the basic organization and function of biological systems. The curriculum thus offers an integrated approach to biology and permits students to attain a relatively high level of general sophistication with complete flexibility of choice for subsequent specialization.

Biocore consists of four courses intended to be taken in sequence: Evolution, Ecology, and Genetics (301/302); Cellular Biology (303/304); Organismal Biology (323/324); and Biological Interactions (333). Each of the courses can be taken as lecture only (3 cr) or, except for the last, as a lecture/lab combination (5-6 cr). New students planning on following the Biocore sequence **should not** take other introductory biology courses. There is extensive overlap in the contents of the various introductory courses, and most majors will not allow credit for both. Math 221 and Chem 104 or 110 or 116 are prerequisites for the sequence, and students planning on participating in Biocore should take these courses during their freshman year. Organic chemistry is a prerequisite for the second semester of Biocore.

All of the Biocore courses are honors courses and very challenging; however, it is not necessary to be in the honors program to participate in Biocore.

### Biocore Courses

**301: Evolution, Ecology, and Genetics, I;** 3 cr (B-I) Prerequisites: Math 221; Chem 104, 110, or 116; previous or concurrent (fall) registration in Chem 341 or 343; or consent of instructor. This course is intended to serve as a foundation for the subsequent courses in the Biocore sequence. The basic concepts of evolution, ecology, and genetics each occupy about one third of the semester. Evolution is discussed in terms of the geological and biological history of the earth, the diversity and classification of organisms, and the development of our ideas about evolution and natural selection. The genetics unit focuses on

transmission genetics and includes discussions of Mendel's laws, the structural and functional organization of chromosomes and their behavior in mitosis and meiosis, and linkage and crossing over. The ecology unit first discusses the relationship of an individual organism to its environment and then goes on to consider populations and various types of communities. Additional topics are the flow of matter and energy through ecosystems and the effects the human species is having on the biosphere. Professors Barton, Denniston, and Howell (Chair).

**302: Evolution, Ecology, and Genetics Laboratory, I; 2 cr (B-I).** Prerequisite: previous or concurrent enrollment in Biocore 301. The laboratory course gives students practical experience working with the concepts introduced in lecture. There are field trips to local marsh, prairie, and woodland communities and projects connected with each. Students also undertake projects which deal with evolutionary relationships, adaptations, Mendelian genetics, cytogenetics, and linkage. This is a writing intensive course with an emphasis on students making observations and generating and testing their own ideas. They report their observations and hypotheses and analyze their data in papers describing each of the projects. Dr. Burgess and Mr. Caslavka.

**303: Cellular Biology, II; 3 cr (B-I).** Prerequisites: Biocore 301; Chem 343 or 341; or consent of instructor. The course deals with the cellular and molecular basis of life, emphasizing the general principles needed to understand and appreciate what cells are and how they work. It focuses on three main themes: (1) the flow of energy in cells, considering how cells obtain, store, and use energy; (2) the flow of genetic information in bacteria, viruses, and higher organisms; and (3) the structure and function of eukaryotic cells, particularly emphasizing cellular motility, the movement of substances into and out of cells, the importance of receptor-ligand interactions, and the regulation of gene expression. Professors Becker (Chair), Eisenstein, and Susman.

**304: Cellular Biology Laboratory, II; 2 cr (B-I).** Prerequisite: previous or concurrent enrollment in Biocore 303 (or Biochem 501 and Genetics 466). Experimental approach to topics such as enzyme catalysis, subcellular fractionation, growth of bacteriophage, genetic mapping, transformation of bacterial cells with DNA, and growth of animal cells in culture. This is a writing-intensive course and we put considerable effort into helping students improve their writing skills. Drs. Burgess and Myers.

**323: Organismal Biology, I; 3 cr (B-I).** Prerequisites: Biocore 301 and 303; or consent of instructor. This physiology course explores the means by which plants and animals interact with their environments to support the basic needs of surviving, obtaining nutrients, and reproducing. The course examines the developments that have evolved in conjunction with the need of animals to search out and procure food - their nutrient and energy source - and contrasts this with plants, which are able to manufacture energy-rich molecules from simple inorganic raw materials. The course focuses on the complex systems of neural and endocrine regulation in animals and hormonal and environmental regulation in plants to understand how cells and organs within an organism maintain communication. We also discuss the regulation of respiration, circulation, and heart function, as well as the mechanisms that underlie the function of the brain. Professors Becker, Dempsey, Oertel (Chair), and Schuler.

**324: Organismal Biology Laboratory, I; 3 cr (B-I).** Prerequisite: previous or concurrent registration in Biocore 323. The laboratory is designed to encourage and develop students' abilities to see questions and design and evaluate experiments to test hypotheses. Students undertake short and long term projects in various areas of plant and animal physiology. This is another writing intensive course. Students write reports, research proposals, and a final paper on their major project, and they present their results in a research symposium near the end of the semester. Dr. Myers.

**333: Biological Interactions, II; 3 cr (B-I).** Prerequisites: Biocore 301, 303, and 323; or consent of instructor. This final course in the Biocore sequence emphasizes the fact that biological systems do not operate in isolation but are characterized by interactions at all levels of organization. The course helps students to build on and integrate the knowledge they have gained in the previous three semesters while addressing current research in topics such as signaling pathways and genetic disease. Professors Allen-Hoffmann (Chair), Colley, Hardin, and Moser.

## Appendix 2

### Example of a synthetic question from the Biocore 333 final exam

(Note: The following hypothetical scenario was something the students had not seen before. Over the course of the semester the we had discussed inbreeding in small populations, developmental biology, the production of secondary compounds by plants [aspens in particular] as defense against herbivores, infectious disease.)

Johnson's Hollow is a nature preserve that is home to a small population of Wisconsin Waxbills, a federally endangered species. The Badger Birders' Society has been maintaining the preserve and keeping records on the number of waxbills there for the past 20 years. Their census data reveals an alarming decrease in the number of adult waxbills over the past few years. Observations during the breeding season indicate the presence of the normal number of eggs per nest but significant numbers of baby birds hatching with wing abnormalities. The preserve consists mostly of woods with a small prairie on the southwest edge. It is surrounded by agricultural land, and the Birders have accused Farmer Brown of using a pesticide that is causing the problem. Farmer Brown maintains that the manufacturers of Bugbegone, the only pesticide that he has ever used, claim it is safe for the environment and that he has never sprayed it on Johnson's Hollow anyway.

The Department of Natural Resources has asked you to chair a committee to investigate the decline in waxbills. The committee is charged with listing possible reasons for the decline and then recommending appropriate studies to be undertaken to decide which is most likely. The studies must be able to be completed in two years. You have the following additional information: the waxbill is able to breed the spring after it hatches and lives up to 5 years. The waxbill's preferred diet is the woodland tent caterpillar, a generalist herbivore. The prairie in Johnson's Hollow has recently been invaded by a particularly aggressive strain of quaking aspen. The weather during the past few years has been unusually dry.

A. (15 points) Give 5 hypotheses for the decline in waxbills, which may or may not be related to the limb abnormalities. For each hypothesis, explain how it would cause the decline.

B. (9 points) Choose 3 of your hypotheses and indicate the types of data you would need to obtain and how you would obtain such data in order to decide whether it was a major factor in the waxbill's decline. Be practical and realistic in proposing data to obtain. State any assumptions you are making.

C. (3 points) Describe how two of the possible reasons for the decline in numbers of waxbills might interact.