25 March 2002 Problem: We (the BIO dept) didn’t score very well in our SACS review of educational effectiveness, but we have a chance to improve: we need to assemble a single set of student learning objectives (SLOs) for the Biology undergrad program. Ideally, the SLOs will identify assessable changes resulting from students’ experiences in our undergraduate program (later, we can work on differences between BA and BS SLOs, as well as concentration-specific SLOs).

To get the ball rolling, look at these 5 pages of course-specific SLOs. Select no more than 12 of the SLOs as being worthy of representing the BIO undergrad program, and return your selections to Lepri by 4/5/02. You can do this electronically or on paper. This optional activity is something you can do IF you’re a professional educator and you want to put a few minutes of thought into where this boat is headed. (Note: many faculty did not state SLOs on their syllabi.)

STUDENT LEARNING OBJECTIVES IN THE DEPARTMENT OF BIOLOGY
AS STATED IN FALL 2001 & SPRING 2002 COURSE SYLLABI

BIO 105, Major Concepts of Biology (Bundy):
Upon completion of this course, students will be able to:
1. apply biological principles in the following subdisciplines to their everyday life: cell biology and energetics, genetics, organismal diversity, and ecology;
2. analyze data tables, charts, graphs, scientific news articles, and experiments; and
3. think about biological issues as they relate to current events, new developments in research, and emerging technology.

BIO 105, Major Concepts of Biology (Almeida):
On completion of this course, the student will be able to understand basic biological issues as presented in current media formats, determine whether such issues are being presented in a scientifically sound manner, and draw informed, valid conclusions on the issues pertaining to biology that you will face as citizens and voters.

BIO 111, Principles of Biology I (Hens):
This course is divided into three major sections. In the first section, you will study basic chemical properties of biologically important molecules including carbohydrates, lipids, proteins, nucleic acids, and water. You will also study enzymes and their importance in the metabolism of living organisms. In the second part of the course, you will study the basic unit of all life- the cell. In this part of the course, you will explore the structure of animal and plant cells and the means by which cells harvest and utilize energy from the environment. You will learn how they reproduce themselves, and how cells become specialized and combine to form tissues and organs during the course of embryonic development. The third part of the course will be focused on structure and function of genes and the means by which genetic traits are passed along from one generation to the next.

BIO 112, Principles of Biology II (Pelli):
1. Add to students’ basic understanding of biological principles and the processes by which scientific knowledge is gained
2. Increase students' appreciation for the evolutionary framework of biology, for the diversity of life, and for the interconnections among all life forms

BIO 271, Mammalian Anatomy (Gouzoules):
In the lecture portion of the course, students will learn human anatomy in a systematic manner. In the lab portion of the course, students will begin the semester with a study of the human skeleton. Later labs will entail a complete cat dissection in order to study muscles, body regions, organs and organ systems. Additional items for study in the lab will include human anatomical models, sheep brains, cow or sheep eyes, and a cow heart. Students successfully completing the course will be able to: identify human bones and bone features; identify and know functions of major muscles; identify and know functions of organs and tissues of all organ
systems, and explain the role of organ systems in maintaining homeostasis. Students should derive from the course a solid understanding of anatomical concepts and terminology, and a greater appreciation of their own physical magnificence!

**BIO 277, Mammalian Physiology (Lepri):**
You should strive to become an expert in mammalian physiology. On the multiple-choice and written exams, you will be required to communicate a working knowledge of organ systems from molecular to organismal perspectives, and to describe how nerves and hormones coordinate physiological systems. You must also show on the exams that you understand homeostasis, membrane potentials, and the central dogma of molecular biology. During your lab work and on exams, you will be required to describe relationships between manipulated and measured variables, and you must show that you can draw accurate conclusions from physiological data that are presented in graphs and flow charts.

**BIO 280, Fundamentals of Microbiology (Almeida):**
On completion of this course, the student will be able to characterize the major bacterial and viral species by physical characteristics, biochemical characteristics, growth characteristics, virulence factors and diseases caused. Students will understand the principles of basic immunology and differentiate between the responses of the cell-mediated and humoral systems of the body to pathogen invasion. Students will be able to apply the principles of epidemiology to novel situations and diseases to both predict and propose solutions for epidemic, pandemic, or endemic infectious diseases of man.

**BIO 322, Plant Diversity (Kirchoff):**
1. Know the characteristics of the major groups of Plants, plant-like Protista, and Fungi, and understand their life cycles. How accomplished: lecture and especially laboratories
2. Be able to use scientific books to learn the characteristics of groups of organisms with which you were previously unfamiliar. How accomplished: paper, work in library
3. Be able to read and understand a scientific paper. How accomplished: reading a paper - group exercises in lecture and lab and take-home assignments

**BIO 341, Invertebrate Zoology (Wendt):**
Biology 341 is designed to expose students to the diverse array of invertebrate animals. The course will approach the study of invertebrates from a functional standpoint highlighting invertebrate evolution, ecology, physiology, and reproduction. Specifically, a student at the conclusion of the course should be able to:
1. Understand and use the basic terminology and concepts encountered in the study of invertebrate animals.
2. Describe our current understanding of broad evolutionary relationships among invertebrate taxa.
3. Compare and contrast major animal groups with regard to movement, growth, feeding, respiration, excretion, and reproduction.
4. Critically evaluate and summarize primary literature on invertebrate animals.
5. Design conceptual experiments to test hypotheses about the way in which invertebrate animals live and function in their environments.

**BIO 355, Cell Biology (Adamson):**
1. To understand the current state of knowledge of cellular processes, including fundamental biochemical properties, cellular components, enzyme function, energetics, and metabolism.
2. To learn about cellular structure, membrane function, cell movement, and cytoplasmic compartments.
3. To understand how cells communicate and what happens when cells do not function properly.

**BIO 355, Cell Biology (Leise):**
By the end of the semester you should understand the important functions of all of the major cellular
organelles and structures and the major biochemical pathways that are involved in the production of energy and intra- and intercellular signaling. You should understand how the genome directs production of cellular proteins and understand the functions of many types of proteins. Most importantly, you should understand processes that are common to all living cells on this planet and have knowledge of important cellular actions that only occur in specific types of cells.

**BIO 392, Genetics (Henrich; identical for BIO 506, Advanced Topics in Genetics):**
1. Acquire basic problem solving skills in areas of transmission, molecular, and population genetics.
2. Connect basic genetic principles with modern applications in genetic diagnostics, gene therapy, genetic engineering, and forensics.
3. Comprehend how genetic approaches are affecting the future workplace in all fields.

**BIO 453, Vertebrate Morphogenesis (Hens):**
The study of contemporary developmental biology is a fascinating and truly multidisciplinary area of modern science. To begin to understand how a complex embryo arises from the single cell of a fertilized egg, and then continues to larval and adult stages, one must draw on knowledge accumulated from the study of many different subjects. At different times during this course, you will focus on the basic biochemistry of protein structure and lipid bilayers, the molecular processes that regulate signaling pathways and gene expression, the cellular mechanisms that facilitate cell adhesion and migration in the embryo, and the anatomical features of several vertebrate embryos. More often than not, you will find it necessary to consider many, if not all, of these aspects together in order to gain a better understanding of a particular developmental process. We will study a number of very specific aspects of vertebrate development in this course, ranging from the biochemistry of fertilization, to the regulation of gene expression during limb development. At the end of the semester you will be able to:
- Describe at the cellular and molecular levels the process of induction as it pertains to embryonic development. You will be able to explain the importance of this process by providing several examples of primary and secondary inductive events that lead to the formation of each of the four major tissue types in the adult.
- List the major categories of growth factors at work in vertebrate development and be able to describe specific developmental events in which each of these factors is functionally important.
- Explain the role of transcription factors and the regulation of gene expression in the differentiation of cells within the vertebrate embryo.

**BIO 477, Animal Physiology (Gatten & Lepri):**
Students will explore the physiological responses of diverse animals to major selective pressures. Energy transfer and the roles of diffusion and transport in nutrient catabolism, oxygen use, and carbon dioxide production will be examined in varied habitats, as will solutions to problems associated with temperature and osmotic regulation. Skill in identifying the neural and hormonal mechanisms that coordinate homeostasis will emerge from examining several examples. Students will also gain experience in evaluating, and communicating in writing, their assessments of scientific reports.
Associated with BIO 477 is **BIO 505, Advanced Topics in Ecological Physiology (Gatten & Lepri):**
Graduate students will explore the physiological responses of diverse animals to major selective pressures. The details of energy-transfer reactions, along with the roles of diffusion and transport in nutrient catabolism, oxygen use, and carbon dioxide production, will be examined in varied habitats, as will solutions to ecological problems associated with temperature and osmotic regulation. Skill in identifying the neural and hormonal mechanisms that coordinate homeostasis will emerge from examining several examples. Graduate students will also gain experience in evaluating, and communicating in writing, analysis and criticism of information contained in the primary scientific literature, along with skill in defining new questions that might be answered using the experimental approach in biological research.
BIO 479, Neurobiology (Leise):
Traditionally, most neuroscience courses are at least 2 semesters long, with one semester devoted to cellular physiology and the second semester devoted to systems physiology. We are going to focus on cellular physiology in the first 2/3 of the semester, but towards the end, we will focus on some of the major neuropsychological systems. By the end of the semester you should understand the basic principles of important neuropsychological functions, including membrane potential, action potential, synaptic signaling, synaptic plasticity, major events of brain development and aspects of sensory and motor integration. Success in this course will prepare you to read and understand more advanced material on nervous system functions.

BIO 509, Advanced Topics in Microbiology (Cannon & Rublee):
1. Develop understanding and familiarity with the nature and diversity of microorganisms.
2. Develop understanding of prokaryotic and eukaryotic cell structure and function.
3. Develop understanding of ecological importance and evolutionary relationship of microorganisms.
4. Present an insight to practical importance of microbiology to humans.
5. Develop ability to think critically about scientific information.
6. Write a scientific term paper using current scientific literature.
7. Demonstrate knowledge on examinations.
8. Develop microbiology laboratory techniques.
9. Understand rationale behind experiments and analyze a research paper in detail.
10. Demonstrate knowledge on a laboratory practical and laboratory unknowns.
11. Practice writing to improve writing skills.

BIO 516, Human Molecular Genetics (LaJeunesse):
After completing this course the student should:
1. Understand the relationship between genotype and phenotype.
2. Apply common genetic and molecular techniques to understand diagnosis and screening.
3. Appreciate the role model systems play in the understanding of the molecular nature of human genetic disease.
4. Learn how disease genes are mapped and cloned.

BIO 522, Landscape Ecology (Mou):
Having successfully completed this course, the student will be able to:
1. explicitly interpret the concepts and implications of landscapes and landscape ecology;
2. explicitly describe the general patch-corridor-matrix landscape model and apply it to any broad scale landscape analysis;
3. comprehend island biogeography, metapopulations and their importance in landscape ecology;
4. have a thorough understanding of the concepts and principles of scale, hierarchy and heterogeneity.

BIO 614, Prenatal Development: Human Embryology and Teratology (LaJeunesse):
The idea of this course is to introduce the student to the following concepts:
1.) Developmental processes, tissue interactions and organogenesis that occur during early human development.
2.) The clinical syndromes, diagnosis, genetic testing, environmental influences and therapy associated with abnormal human development.
3.) the experimental principles used to determine the molecular and genetic basis of human congenital disease.

Included in SACS data set as Student Learning Objectives for BA, BS, BSMT, and all concentrations

Population Thinking:
a. Understand how collections of organisms/molecules behave differently than individual organism/molecules.
i. Collective behavior possible based on communication  
ii. Each individual can act independently-allowing competition etc. to exist  
   (1) Examples: competitive inhibitors, competitive exclusion, natural selection  

b. Dynamic equilibrium  

Systems Analysis/Modeling:  

a. Positive and negative feedback loops  
b. Organisms/ecosystems of individual parts that interact with each other to produce a functioning whole  
c. Thinking in context—we can teach biological process in the context in which they occur. Ex: osmosis can be taught in the context of kidney function.  
d. Quantitative skills (in a Biological context):  

e. Algebra  
   i. Compute dilutions and mix solutions  
   ii. Manipulate simple algebraic equations  
   iii. Convert number to and from logarithms  
   iv. Solve power equations using logarithms  

f. Frequencies  
   i. Convert absolute numbers to frequencies  
   ii. Perform calculations both on the basis of absolute  

An awareness of scale (example follow)  

i. Of reactions  
ii. Of ecological processes  
iii. The sized of organisms  
iv. Geological time  

h. Statistical inference and statistical testing of hypotheses  

i. Familiarity with at least one basic statistical test (examples follow)  
   (1) T-test  
   (2) Chi-square  

ii. Measurement  
   (1) Range and mean  
   (2) Measures of variability and error  
   (3) The difference between accuracy and precision  

i. Interpretation of quantitative data  
   i. Translate equations and graphs into verbal descriptions  
   ii. Translate verbal descriptions into equations and graphs  

Library Skills:  

a. Find original research papers using databases available through the library.  

Thinking and Writing Skills:  

a. Students should have the ability to write in complete sentences and well-constructed paragraphs.  
b. Compare and contrast two items or processes in writing using complete sentences and paragraphs.  
c. Summarize the major concepts in a research or review journal article, in speech and writing.  

d. Scientific Method  
   i. Forming hypotheses  
   ii. Testing hypotheses (non statistical)  
   iii. Controls  

**Included in SACS data set as Student Learning Objectives for MS degree program:**  
We expect students to learn advanced concepts in biology and to be familiar with the scientific literature in the field of specialty within biology. We expect students to apply basic and advanced principles of biology to engage in and complete original research projects. This training encompasses a mixture of data analytical and statistical principles, principles of biology, and practical skills such as the advanced use of computers and laboratory equipment. We expect students to develop a research proposal and then execute and report their
findings in a written thesis. By applying basic principles of biology, and learning advanced concepts based on these principles, we intend to produce students who are experienced in a research setting and who can apply biological principles to deal with and solve unresolved biological problems.