

COURSE OUTLINE**Biology 103**
Molecular Biology and Genetics**I. Catalog Statement**

Biology 103 is an extension of the study of molecular biology, cell biology and genetics introduced in Biology 101. The course examines the structure and function of nucleic acids and proteins in the living cell, and how they are studied and manipulated in the laboratory. Topics include regulation of gene expression, recombinant DNA technology, chromosome mapping, and genome sequencing.

Total Lecture Units: 4.0

Total Course Units: 4.0

Total Lecture Hours: 64.0

Total Faculty Contact Hours: 64

Prerequisites: Biology 101 and Chemistry 105 (Chemistry 105 may be taken concurrently)

II. Course Entry Expectations

Skill Level Ranges: Reading 5, Writing 5, Listening/Speaking 5, Math 3

Prior to enrolling in the course, the student should be able to:

1. summarize the scientific method and its application in the biological sciences;
2. explain how the unity of the natural world is explainable by evolution from common ancestry;
3. identify the major biological organic compounds based on functional groups;
4. discuss the importance of water and how its properties relate to its molecular structure;
5. identify the properties of lipids, carbohydrates, proteins and nucleic acids;
6. describe the structure of both prokaryotic and eukaryotic cells;
7. demonstrate the importance of surface to volume ratio in cell physiology;
8. summarize the basic physical principles behind cellular energetics;
9. give a rationale for each step of cell respiration and photosynthesis and the holistic view of these two processes;
10. summarize the relationships between meiosis and Mendelian genetics;
11. solve word problems covering a wide array of inheritance patterns;
12. describe the processes of replication, transcription, and translation of the DNA molecule;
13. understand some of the basic mechanisms of gene regulation in prokaryotes and eukaryotes;
14. discuss some of the basic techniques in biotechnology.
15. be familiar with the system of classification of compounds by structure which is the framework of organic chemistry;
16. delineate the principles of organic chemical reactions through techniques of lecture, laboratory, problem solving and computer-simulated experiments;
17. acquaint themselves with the laboratory methods and specialized instruments typically used in organic chemistry;
18. keep accurate laboratory records;

19. prepare themselves for pre-professional examinations that include organic chemistry, e.g. MCAT, DAT, pharmacy and dental hygiene aptitude examinations;
20. read and evaluate scientific material of significance to them as citizens.

III. Course Exit Standards

Upon successful completion of the course, students will be able to:

1. summarize the steps involved in the expression of genes, and some of the control mechanisms that cells can apply at each step;
2. explain the primary experimental techniques used to purify and characterize proteins and nucleic acids;
3. explain the methods employed in basic recombinant DNA technology, including the use of restriction enzymes, electrophoresis, library construction and screening, blotting and hybridization, DNA sequencing, and the polymerase chain reaction (PCR);
4. describe the composition of genomes in higher organisms, including the various classes of repetitive DNA, and the various types of DNA polymorphisms used to genotype individuals within a species;
5. explain the steps involved in producing transgenic and knockout organisms;
6. solve problems involving the mapping of genes on eukaryotic chromosomes using three point crosses and other methods;
7. explain the rationale for sequencing genomes and describe the basic strategies for doing so.

IV. Course Content

Total Faculty Contact Hours = 64 hours

- | | |
|---|----------|
| A. The structure and biosynthesis of nucleic acids | 4 hours |
| B. The structure and biosynthesis of proteins | 4 hours |
| C. Regulation of gene expression | 6 hours |
| 1. Transcriptional control | |
| 2. Differential RNA processing | |
| 3. Translational control | |
| D. Growing cells in the laboratory | 4 hours |
| E. How macromolecules are manipulated, analyzed, and put to practical use | 18 hours |
| 1. Protein purification and analysis | |
| 2. Antibodies and their uses in the lab | |
| 3. Recombinant DNA technology | |
| a. Restriction enzymes, ligase, and transformation | |
| b. Electrophoresis and the use of micropipets | |
| c. Restriction mapping | |
| d. Library construction and screening | |
| e. Blotting and hybridization | |
| 4. DNA sequencing | |
| 5. The polymerase chain reaction (PCR) | |

- | | |
|---|---------|
| F. Chromosome ultrastructure and genome composition in higher organisms | 6 hours |
| G. Detection and applications of DNA polymorphisms | 4 hours |
| H. The production of transgenic and knockout organisms | 6 hours |
| I. Mapping genes and molecular markers onto eukaryotic chromosomes | 8 hours |
| 1. Genetic mapping using 3-point crosses | |
| 2. Cytological and physical mapping | |
| J. Sequencing genomes and reasons for doing it | 4 hour |

V. **Methods of Instruction**

The following instructional methodologies may be used in the course:

1. Overheads of a lecture note “skeleton” (a required purchase) are presented and filled in.
2. Black and/or white board presentation is also used.
3. Power Point presentations and video clips are occasionally used.
4. Some laboratory work is performed

VI. **Out of Class Assignments**

The following out of class assignments may be used in the course:

1. Four problem sets will be assigned as homework to be turned in for grading.
2. Students will also be emailed an “unknown” DNA sequence and be required to identify it by performing an online sequence similarity search. They will analyze the sequence and its deduced protein using online tools, and do a literature search using the database Medline.

VII. **Methods of Evaluation**

The following methods of evaluation may be used in the course:

1. Three two-hour written examinations and one two-and-one-half-hour final examination will be given. Exams will consist primarily of short answer and problem solving questions.
2. Quizzes will be given on the structures of the amino acids and nitrogenous bases, and on restriction mapping and laboratory work.

VIII. **Textbooks**

Lodish et al., *Molecular Cell Biology*, 7th edition. W.H. Freeman, New York, N.Y., 2012.

12th grade Textbook Reading Level. ISBN: 142923413X

Pierce, *Genetics: A Conceptual Approach*, 4th edition. W.H. Freeman, New York, N.Y., 2012.

12th grade Textbook Reading Level. ISBN: 1429293314

IX. **Student Learning Outcomes**

1. Students will be able to summarize the steps involved in gene expression in prokaryotic and eukaryotic organisms, and explain various methods by which cells regulate this expression.

2. Students will be able to explain several methods for purifying proteins, and to summarize the roles of antibody molecules in the body and in the lab.
3. Students will be able to explain basic methods in recombinant DNA technology, and to interpret data and solve problems involving those methods.
4. Students will be able to analyze data and solve genetics problems involving DNA polymorphisms, linkage mapping, and co-segregation of alleles within pedigrees.