El Camino College

COURSE OUTLINE OF RECORD - Official

I. GENERAL COURSE INFORMATION

Subject and Number: Biology 103
Descriptive Title: Fundamentals of Molecular Biology

Course Disciplines: Biological Sciences

Division: Natural Sciences

Catalog Description: This course is an introduction to molecular biology. The student will study DNA, RNA and protein structure; protein biochemistry; protein purification and analysis; genome organization of viruses, prokaryotes and eukaryotes, DNA replication; transcription and splicing; regulation of transcription; translation; and recombinant DNA technology. The student will also explore the uses of DNA technology, such as forensics and agriculture, as well as the ethical considerations of these uses.

Conditions of Enrollment: **Prerequisite**

Biology 101 or

Biology 101H
AND

Biology 102 or

Biology 102H
with a minimum grade of C in each course

AND

Chemistry 7A
with a minimum grade of C or concurrent enrollment

Course Length: [X] **Full Term** [ ] **Other (Specify number of weeks):**
Hours Lecture: **3.00 hours per week** [ ] **TBA**
Hours Laboratory: **0 hours per week** [ ] **TBA**
Course Units: **3.00**

Grading Method: **Letter**
Credit Status **Associate Degree Credit**

Transfer CSU: [X] **Effective Date: 1/20/1998**
Transfer UC: [X] **Effective Date: Fall 1998**

General Education:
El Camino College:

	1 – Natural Sciences	
	Term:	Other:
CSU GE:	**B2 - Life Science**	
	Term: Fall 2008	Other:
IGETC:	**5B - Biological Science without a Lab**	
	Term: Fall 2008	Other:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. The student will understand and apply principles of the scientific method; recognizing an idea based on reproducible evidence.
2. The student will be able to provide a detailed explanation of how the unit-by-unit transfer of genetic information occurs from DNA to RNA to protein.
3. The student will be able to explain various prokaryotic and eukaryotic gene expression control mechanisms.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. Compare and contrast the structures and functions of DNA and RNA.

   Essay exams
2. Describe the basic building block, the amino acid, of proteins.

   Essay exams
3. Explain the properties of the twenty amino acids and know the three letter and one letter abbreviations for each amino acid.

   Essay exams
4. Compare and contrast the four levels of protein structural organization.

   Essay exams
5. Identify major post-translational modifications.

   Multiple Choice
6. Describe techniques used in protein purification and analysis.

   Essay exams
7. Compare and contrast the genomes of viruses, prokaryotes, and eukaryotes.

   Embedded questions
8. Compare and contrast DNA replication in eukaryotes and prokaryotes.

   Essay exams
9. Discuss initiation, elongation, and termination of transcription and translation.

Essay exams

10. Describe the major modifications at the 5' and 3' ends of eukaryotic mRNAs, explain how they arise, and state their importance.

    Essay exams

11. Explain mechanisms underlying intron removal and alternative splicing. Discuss the importance of alternative splicing in generating diversity of gene products.

    Essay exams

12. Describe the regulation of gene expression at the transcriptional level in prokaryotes and contrast this with eukaryotic transcriptional control.

    Essay exams

13. Discuss post-transcriptional, translational, and post-translational controls of eukaryotic gene expression.

    Essay exams

14. Explain key differences between eukaryotic and prokaryotic protein synthesis.

    Essay exams

15. Provide an integrated overview and explain the importance of the flow of information from DNA to RNA to protein.

    Essay exams

16. Describe tools and techniques used in nucleic acid study including recombinant DNA technology and gene cloning.

    Essay exams

17. Compare and contrast varied applications of DNA technologies from forensic uses to the generation of genetically modified organisms for agricultural, pharmaceutical, and research based purposes.

    Essay exams

18. Discuss ethical considerations involving the use of DNA based technologies eukaryotic.

    Presentation

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	1.5	I	Introduction: Class organization; Requirements Review: Scientific Method
Lecture	3	II	Review: Cellular Structure
Lecture	1.5	III	Central Dogma of Molecular Biology (Biological Information Flow)
Lecture	4.5	IV	Structure of Protein; Protein Biochemistry
Lecture	6	V	Techniques of Protein Study A. Chromatography B. Gel Electrophoresis C. Western Blot D. Fluorescence and Immunological Based Methodologies E. Sequencing
Lecture	3	VI	Structures and Functions of DNA and RNA

Lecture	4.5	VII	Genomes A. Prokaryotic B. Eukaryotic C. Viral
Lecture	3	VIII	DNA Replication
Lecture	4.5	IX	Transcription and Processing (including Alternative Splicing)
Lecture	4.5	X	Translation
Lecture	6	XI	Control of Gene Expression A. Prokaryotic B. Eukaryotic
Lecture	7.5	XII	Techniques of Nucleic Acid Study A. Recombinant DNA and Gene Cloning 1. Tools and techniques include restriction enzymes, vectors (e.g. plasmids, viruses) B. Libraries 1. Genomic 2. cDNA, 3. Chromosomal C. PCR 1. Polymerase Chain Reaction 2. RT-PCR D. Gel Electrophoresis 1. Southern and Northern Blots E. DNA Sequencing F. CRISPR-Cas9
Lecture	4.5	XIII	Application of DNA Technology and Discussion of Ethical Considerations
Total Lecture Hours		54	
Total Laboratory Hours		0	
Total Hours		54	

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. **PRIMARY METHOD OF EVALUATION:**

Substantial writing assignments

B. **TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:**

Scenario: You are working in a laboratory where culture plates in an incubator have bacterial growth. You notice that in several plates there is also fuzzy growth that 1) looks different from the bacterial growth and 2) is surrounded by a clear area, i.e. no growth is present. In paragraph form, answer the following questions:

A) What QUESTION(S) would you ask?

B) What HYPOTHESIS would you propose?

C) What PREDICTION, based on your HYPOTHESIS, would you make that can be tested?

D) What EXPERIMENT might you propose to test your PREDICTION?

C. **COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:**

1. Given the following research article, respond to the following questions in essay format:

   ARTICLE: “Small RNAs derived from the 5' end of tRNAs can inhibit protein translation in human cells" by Andrew Sobala and Gyorgy Hutvagner (RNA Biology, April 2013, 10:4, 553-563).

   A) What is an ABSTRACT and what does it accomplish?

   B) In no more than THREE sentences, summarize the key point of the paper. The limit of the number of sentences is meant to make sure you are concise.

   C) Pick and describe any TWO EXPERIMENTAL METHODS that were performed to carry out the work. Be sure to include in your description what each method accomplishes. Research the methods and cite your sources in your assignment.

   D) DATA INTERPRETATION: Evaluate Figure 1. Break the analysis down. Start with part A, then proceed with part B. Summarize what each part (A, B) of the figure suggests/demonstrates.

2. Given the following review article, respond to the following questions in essay format:

   ARTICLE: “CRISPR-Cas9: A promising tool for gene editing on induced pluripotent stem cells” by Eun Ji Kim, Ki Ho Kang, and Ji Hyeon Ju (Korean Journal of Internal Medicine, 2017, 32:42-61).

   A) Describe the mechanism underlying CRISPR-Cas9 function.

   B) CRISPR-Cas9 utility is focused on genetic mutation correction. Provide two additional examples of how the technology can be used.

C) Ethical concerns have been raised about the technology. What is your opinion regarding which human traits should be targeted for editing? Should there only be therapeutic considerations? Should nontherapeutic enhancements be a consideration?

D. **OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**

Essay exams
Other exams
Quizzes
Class Performance
Term or other papers
Multiple Choice
Completion
Matching Items
True/False

V. INSTRUCTIONAL METHODS

Discussion
Lecture
Multimedia presentations

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Required reading
Written work

Estimated Independent Study Hours per Week: 6

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
Gerald Karp. Cell and Molecular Biology: Concepts and Experiments. 8th ed. John Wiley and Sons, Inc. , 2016.

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**
Scientific articles (research or review) and articles in science magazines and newspapers (secondary sources) as the instructor deems relevant for the subject matter presented in the lecture.

D. **OTHER REQUIRED MATERIALS**

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite Biology-101 or	
Course Prerequisite Biology-101H AND	
Course Prerequisite Biology-102 or	
Course Prerequisite Biology-102H AND	
Course Prerequisite Chemistry-7A	

B. Requisite Skills

Requisite Skills
Be familiar with the protists as a number of them are used as experimental tools in recombinant DNA technology and as model organisms for the elucidation of molecular processes (e.g. Tetrahymena and telomerase function). BIOL 101 - Compare and contrast representative phyla of protists. BIOL 101H - Compare and contrast representatives phyla of protists.
Be familiar with the fungi as a number of them are used as experimental tools in recombinant DNA technology and techniques of protein study (e.g. Saccharomyces cerevisiae and the yeast two hybrid system). BIOL 101 - Recognize the various protist, fungal, plant, and animal phyla viewed in the lab. BIOL 101H - Compare and contrast the life cycles of the fungal phyla.
Be able to analyze various experimental scenarios and discuss elements of the scientific method. BIOL 102H - Apply the principles of the scientific method to experimental cases. BIOL 102 - Apply the principles of the scientific method to experimental cases.
Familiarity with scientific terminology and literature (e.g textbook, research articles). BIOL 102H - Compose a laboratory report with the following elements (or variations thereof): Title, Abstract, Introduction, Materials and Methods, Results, Discussion, and References. BIOL 102 - Compose a laboratory report with the following elements (or variations thereof): Title, Abstract, Introduction, Materials and Methods, Results, Discussion, and References.
Be able to identify and describe cellular structures as a number of them are critical for molecular biological processes. BIOL 102H - Relate cellular structures with their functions. BIOL 102 - Relate cellular structures with their functions.
Be able to describe dynamic cellular processes as students will need that experience to discuss dynamic molecular biological processes such as DNA replication, transcription and translation. BIOL 102 - Relate cellular structures with their functions. BIOL 102H - Relate cellular structures with their functions.

Familiarity with the structures. Structural considerations are essential in an in-depth discussion of DNA replication, transcription, and translation. BIOL 102 - Distinguish between the major types of biologically significant polymers. BIOL 102H - Distinguish between the major types of biologically significant polymers.
Familiarity with the structure. Structural considerations are essential in understanding protein function in DNA replication, transcription, and translation. BIOL 102H - Distinguish between the major types of biologically significant polymers. BIOL 102 - Distinguish between the major types of biologically significant polymers.
Be familiar with the basic precepts of Mendelian genetics and key aspects of meiosis as they are essential in the continuity of life. This is fundamental in understanding the biological flow of information. BIOL 102 - Recognize the phases of mitosis using the compound microscope. BIOL 102H - Recognize the phases of mitosis using the compound microscope.
Be familiar with prokaryotic cellular structure and propagation as bacteria are used as important tools in recombinant DNA technology and as model organisms for the elucidation of molecular processes. BIOL 102H - Describe the characteristics of significant bacterial divisions. BIOL 102 - Describe the characteristics of significant bacterial divisions.
Be familiar with viral structure and mode of propagation as viruses can be used as important tools in recombinant DNA technology and the elucidation of molecular processes. BIOL 102H - Explain the effects that prokaryotes have on the environment. BIOL 102 - Explain the effects that prokaryotes have on the environment.
Be familiar with key components of a scientific paper. BIOL 102 - Compose a laboratory report with the following elements (or variations thereof): Title, Abstract, Introduction, Materials and Methods, Results, Discussion, and References. BIOL 102H - Compose a laboratory report with the following elements (or variations thereof): Title, Abstract, Introduction, Materials and Methods, Results, Discussion, and References.
Be able to recognize the general formulae for the major classes of organic compounds. Be familiar with organic molecule representations. CHEM 7A - For any given organic compound, the student will analyze IR and proton NMR spectra of the compound to determine its structural features and then predict its structure. MS, UV and carbon-13 NMR spectra are used to a lesser extent.
Be able to distinguish between types of covalent and noncovalent bonds. Familiarity with the types of bonds between and within the biological molecules is essential to understanding the relationship between structure and function. CHEM 7A - For any given organic compound, the student will analyze IR and proton NMR spectra of the compound to determine its structural features and then predict its structure. MS, UV and carbon-13 NMR spectra are used to a lesser extent.
Familiarity with organic compound synthesis. The syntheses of protein and nucleic acids are discussed. CHEM 7A - For the major classes of aliphatic hydrocarbons and of organic halides, alcohols and ethers, the student will describe how to distinguish between different compounds using simple tests.
Understand how chromatographic methodologies separate components from mixtures. Proteins are separated from cellular mixtures for study. A number of separation methodologies are discussed in the Techniques of Protein Study lecture. CHEM 7A - In the laboratory the student will record IR spectra using an infrared spectrometer.
Be familiar with the study of the spatial arrangement of atoms within molecules. Protein and DNA exist as three dimensional structures and structural considerations are essential to function. CHEM 7A - For any given organic compound, the student will predict and explain properties in terms of structure and bonding.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification

D. Recommended Skills

Recommended Skills

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by J. Oyama, L. Scharlin, R. Wishard on 10/01/1997.

BOARD APPROVAL DATE:

LAST BOARD APPROVAL DATE: 12/18/2017

Last Reviewed and/or Revised by Teresa Palos on 10/11/2016

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