Lecture Contact Hours: 48-54; Homework Hours: 96-108; Total Student Learning Hours: 144-162
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

BIOLOGY 230 – PRINCIPLES OF CELLULAR, MOLECULAR AND EVOLUTIONARY BIOLOGY

3 hours lecture, 3 hours laboratory, 4 units

Catalog Description
Survey of the general principles of cell, molecular and evolutionary biology at an advanced level. Emphasis is on the following topics: cellular structure and processes including energy metabolism, membrane transport and cell cycle/cell division; molecular genetics including recombinant DNA; Mendelian and non-Mendelian genetics; communication between cells; and the current models for cellular evolution. Laboratory exercises emphasize the application of these topics to biotechnology. This course along with BIO 240 is the recommended biology sequence for life science majors. It is suggested that students contact the anticipated transfer institution to ascertain specific transfer requirements for their major. *Not open to students with credit in BIO 220, 221.*

Prerequisite
"C" grade or higher or "Pass" in CHEM 141 or equivalent

Recommended Preparation
"C" grade or higher or "Pass" in ENGL 110 or equivalent

Entrance Skills
Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:
1) Determine the numbers of each type of subatomic particle present within a given atom.
2) Write the chemical formula of a compound.
3) Classify bonds into their various types–nonpolar, polar, ionic–and predict the polarity of molecules.
4) Perform calculations including the molecular weight of a solute.
5) Calculate the hydrogen and hydroxide ion concentrations and pH of an aid, a base or a buffer solution.
6) For graphs of linear functions, determine the slope and intercept of the line.
7) For graphs of non-linear functions, interpolate values from the curve.
8) Produce essays substantially free of major spelling, grammar, punctuation, sentence structure and usage errors that seriously interfere with communication.
9) Write a multi-paragraph essay focusing on a thesis statement and demonstrating an understanding of the concepts of an introduction, a body and conclusion as well as adequate development, unity of idea and coherence.
10) Write a position paper that asserts a thesis and provides adequate documented support from at least one source.
11) Use the MLA format to document sources in writing.

Course Content
1) Methods of scientific inquiry including hypothesis testing and limitations, maintaining a laboratory notebook, organizing, graphing and interpreting data, use of the calculator and computer software in data analysis, and reading/interpretation of primary literature
2) Properties of living organisms and model systems used in cell and molecular biology
3) Basic biochemistry including nucleic acids, proteins, carbohydrates and lipids
4) Classic experiments in cell and molecular biology
5) DNA replication as a model system for biological processes

6) Molecular genetics including the genetic code, RNA, protein synthesis and mutation
7) RNA and proteins as the expression products of genes and the basis of cellular function
8) Control of gene expression in prokaryotic and eukaryotic cells
9) Prokaryotic and eukaryotic cell structure and function
10) Communication between cells: cellular receptors, chemical messengers, with implications for disease
11) Principles of cellular membrane transport including diffusion, osmosis, passive and active transport
12) Enzymes structure and function including factors that impact enzyme activity
13) Cellular respiration
14) Photosynthesis
15) Cell cycle, mitosis and meiosis
16) Principles of Mendelian and non-Mendelian genetics including analysis of mono and dihybrid crosses, X-linked traits, incomplete dominance, and linked genes
17) Current models on the origin and evolution of cellular life
18) Orientation to the tools and techniques in modern biology and biotechnology
19) Recombinant DNA technology
    a. Plasmid vectors
    b. Restriction enzymes
    c. Bacterial transformation
    d. Gene expression
20) Protein expression, purification, qualitative and quantitative analysis
21) Electrophoresis: its use in DNA and protein isolation and characterization and the basic principles of Western blot hybridization
22) Analysis of evolutionary relatedness of proteins by electrophoresis and bioinformatics using web-based databases such as BLAST
23) PCR
24) Qualitative and quantitative analysis of enzymes including evaluation of factors that impact enzyme activity, computer-assisted data analysis
25) DNA fingerprinting
26) Other topics in biotechnology

Course Objectives

Students will be able to:

1) Work alone or in teams, utilizing the methods of scientific inquiry to solve problems in cellular and molecular biology by formulating and testing hypotheses, collecting, analyzing and presenting qualitative and quantitative data, and formulating conclusions.
2) Correctly use standard cellular and molecular biology equipment including but not limited to spectrophotometers, micropipettors, centrifuges, and electrophoresis apparatus.
3) Describe the different types of biological molecules and their role in cells.
4) Describe the basic structure of prokaryotic and eukaryotic cells and the functions of the cells and their component parts.
5) List, organize and differentiate between basic cellular and molecular biological processes and explain each process.
6) Analyze and predict outcomes for selected examples of biological processes based on experimental data in areas such as energy metabolism, cell division, cell communication and expression of genes.
7) Identify the steps of mitosis, meiosis and recombination in plants and animals, and relate these processes to the cell cycle.
8) Use the Principles of Mendelian and non-Mendelian Genetics to solve problems in genetics.
9) Read for comprehension and analyze selected current papers from the primary biology literature as published in established scientific journals such as Science, Nature, and Proceedings of the National Academy of Sciences (PNAS).
10) Use hypothesis testing to analyze experiments that determined the basis of current cellular and molecular models and theories (i.e., establishment of DNA as the genetic material).

11) Demonstrate standard methods for laboratory notebook documentation, presentation and analysis of data, including graphing and simple statistics, using both a calculator and computer software.

Methods of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Quizzes and exams that measure students' ability to recognize, explain and provide examples of the concepts, principles, techniques and technologies associated with the course content and learning outcomes.
2) Independent and team research projects/papers that require students to formulate a strategy for problem solving, assessing and reporting data, drawing relationships and conclusions.
3) Laboratory and field exercises, reports and notebooks that demonstrate research, writing, data analysis and critical thinking skills.

Special Materials Required of Student

1) Calculator
2) USB flash drive
3) Access to Internet, printer

Minimum Instructional Facilities

1) Smart lecture and laboratory classrooms with sink, hood, gas, glassware (beakers, flasks, graduated cylinders), computers with data analysis, graphics and web browsing software
2) Special requirements: compound and dissecting microscopes, student spectrophotometers, refrigerator, water baths, incubators, electrophoresis equipment, and other related biotechnology equipment

Method of Instruction

1) Lecture and demonstration
2) Laboratory experiments/exercises
3) Group projects/discussion
4) Computer-based investigations

Out-of-Class Assignments

1) Assignments that require reading and analysis of concepts in cell and molecular biology
2) Solving problems in cell and molecular biology
3) Preparation of laboratory assignments and reports

Texts and References

1) Required (representative examples):
   a. Brooker, et al. *Biology*. 4th edition. McGraw-Hill Higher Education, 2017.
   b. Selected primary and secondary literature sources necessary for comprehension of laboratory exercises.
2) Supplemental (representative example): None

Student Learning Outcomes

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

1) Work as a part of a team to use the methods of scientific inquiry to solve complex problems in cell and molecular biology.
2) Convey data analysis and conclusions by correctly using scientific terminology and writing standards.
3) Perform laboratory exercises designed to solve basic problems in cell & molecular biology by correctly utilizing appropriate laboratory tools and equipment.

4) Accurately explain and utilize fundamental concepts in cell & molecular biology including cell structure & function, basic metabolic processes including photosynthesis & respiration, principles of classical and molecular genetics, and enzymes and membrane functions.
5) Demonstrate the ability to read for understanding primary and secondary literature sources in cell & molecular biology.