*Lecture Contact Hours: 48-54; Homework Hours: 96-108;*
*Laboratory Contact Hours: 48-54; Homework Hours: 0;*
*Total Student Learning Hours: 192-216*

**CUYAMACA COLLEGE**
COURSE OUTLINE OF RECORD

## BIOLOGY 120 – PRINCIPLES OF BIOLOGY

3 hours lecture, 3 hours laboratory, 4 units

**Catalog Description**
Survey of the basic biological principles with particular emphasis on the molecular and cellular aspects of the organism. The unifying concepts of biology such as organization, metabolism, genetics and evolution are discussed. The laboratory component extends and complements the lecture with hands-on experiences that include experimental design, light microscopy, cellular biology, enzymes, data analysis and interpretation, organismal biology, genetics, systematics, and ecology. Meets transfer requirements for non-majors.

**Prerequisite**
None

**Course Content**
**LECTURE**
1) Introduction to the goals and methods and limitations of scientific inquiry and the manner in which these methods are used in solving biological problems
2) The difference between hypotheses, theories and laws in science
3) Description of the properties shared by all forms of life
4) Survey of diversity of life forms in the three domain classification system and the relationship of viruses to living things, including nomenclature and classification
5) The composition and structure of matter, the formation of chemical bonds, and the structure of chemical reactions and the properties and significance of water in biological systems
6) Acids, bases and redox reactions and their role in the cell
7) The structure, function and relationships among biological molecules including nucleic acids, proteins, carbohydrates and lipids, and the processes of DNA replication, transcription and translation
8) Differences and similarities between prokaryotic and eukaryotic cells and viruses
9) Parts, structures and functions of cellular components
10) Chemical composition and architecture of the cell membrane and its role in exchange of matter in the cell
11) Mechanisms of energy acquisition and transformation in cells, including first and second laws of thermodynamics
12) The structure and function of enzymes in metabolic processes
13) Anabolic and catabolic processes and their interrelationship
14) Capture of energy into biological molecules: photosynthesis
15) Extraction of energy from biological molecules: glucose oxidation, alcoholic and lactic acid fermentation
16) Inter-relationship between photosynthesis and respiration and significance of the balance between the two to life on Earth (producers and consumers)
17) Cell growth and division, including production of somatic and reproductive cells by mitosis and meiosis
18) How genetic information is passed from parents to offspring; Mendelian and non-Mendelian inheritance, sex-linked inheritance and relationship of inheritance patterns to physical chromosome structure

19) Evolution as a unifying principle of biology, the evidence supporting evolution and natural selection, and the theories behind the origin of life and eukaryotic cells

**LAB**

1) Microscopy
2) Prokaryotic and eukaryotic cellular structures
3) Organic constituents of life including nucleic acids, carbohydrates, proteins and lipids
4) Classification, structure and function of living organisms including bacteria, fungi, protists, plants and animals
5) Molecular movement, net diffusion and osmosis
6) Enzymes
7) Photosynthesis
8) Respiration and fermentation
9) Mitosis and meiosis
10) Mendelian and Post-Mendelian genetic and relationship to modern molecular genetics
11) Representative mammalian anatomy
12) Relationships among organisms and physical environment in ecosystems

**Course Objectives**

**Lecture**

Students will be able to:

1) Outline the methods and activities of scientific inquiry used to solve problems in biology and identify limitations to the types of questions that can be answered scientifically.
2) Distinguish among statements that describe a hypothesis, a theory or natural law.
3) Determine whether an entity is living based upon a description of its properties.
4) Classify an organism into the appropriate domain and kingdom based upon its characteristics; justify the reasons for placing it there.
5) Explain how the various components of matter can be organized into biological molecules.
6) Compare and contrast the structures, roles and interrelationships of biological molecules including nucleic acids, proteins, carbohydrates and lipids.
7) Given a molecule of DNA with a specific nucleotide sequence, demonstrate how to create the complementary strands of the double helix, transcribe one of the strands into mRNA, and translate into a peptide.
8) Describe the relationship between structure and function in proteins and the implications of changes in structure on the operation of a cell.
9) Construct a model of a prokaryotic and eukaryotic cell that includes the various sub-cellular structures and describes their inter-relationships and possible origins; contrast this model with that of a typical virus.
10) Construct a model that represents the chemical composition and architecture of a cell membrane and predict the flow of molecules across the membrane based on osmolarity on opposite sides of the membrane.
11) Explain how enzymes allow anabolic and catabolic metabolism in a cell to operate in terms of the cell's energy flow.
12) Describe the processes of photosynthesis, glucose oxidation, and fermentation in terms of their energy flow and conversion properties, and their interrelationships.
13) Compare and contrast the functions and mechanisms of mitosis and meiosis in a diploid organism's life cycle.
14) Solve problems that require calculation of the probability of the inheritance of a particular genetic allele for Mendelian and non-Mendelian scenarios.
15) Appraise the evidence for evolution and illustrate the key concepts using an example.
16) Apply the knowledge gained in the course to assess contemporary problems/situations in biology.

**Lab**

1) Perform the basic activities of scientific inquiry, including presentation of data in the form of tables, charts and graphs, design of experiments, collection of data, and critical analysis of data.
2) Use both compound and stereo microscopes to study cells and organisms.

3) Describe the relationship between respiration and photosynthesis, producers and consumers and the role of each of these in ecosystems.
4) Relate membrane transport examples to real world situations.
5) Test for the presence of carbohydrates, lipids, proteins and nucleic acids, and recognize the relationships between the testing methods and the chemical properties of these compounds and the significance of these molecules in living organisms.
6) Measure the rate of enzyme catalyzed reactions under different conditions, and explain the significance to living systems.
7) Recognize the roles of light, $CO_2$ and pigments in photosynthesis and to measure the rate of photosynthesis under different conditions.
8) Compare human-controlled oxidation to glucose oxidation in respiration and to measure the rate of respiration under different conditions.
9) Compare the role of mitosis to meiosis in cellular division and to recognize the different phases of these processes.
10) Solve problems in genetics based on Mendelian and non-Mendelian models of inheritance.
11) Describe the relationship between classical genetics and modern molecular genetics, and the significance of molecular genetics in the modern world.
12) Understand the structure and functional relationships of plants with other biotic and abiotic factors in ecosystems.
13) Study the structure and function of the major organs and organ systems in a representative mammal and compare and contrast to those of humans.
14) Understand the basis of the classification of the animal kingdom as well as recognize members of the different animal phyla.

**Method 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 structures, systems and processes associated with living organisms.
2) Written assignments that measure students' ability to analyze contemporary issues in biology based on historical and modern scientific evidence.
3) Research projects that require students to analyze data, interpret and draw conclusions based on scientific sources.
4) Scenario-based problems that model real-world situations and require students to apply classroom/textbook knowledge.
5) Lab practical exams that demonstrate proficiency in specific laboratory skills and knowledge
6) Written and oral lab quizzes
7) Formal and informal lab reports that demonstrate the student's ability to recognize and perform the various activities of scientific inquiry
8) Group discussions and projects that demonstrate ability to construct experiments and analyze data to answer scientific questions

**Special Materials Required of Student**
None

**Minimum Instructional Facilities**
**LECTURE**
1) Smart classroom
**LAB**
1) Smart classroom laboratory facilities with writing board, overhead projection system, utilities including hot/cold/DI water
2) Microscopes, both compound and binocular dissecting scopes

3) Computers with software for construction of charts and graphs
4) Equipment including balances, glassware, measuring devices, computer-based data acquisition system

**Methods of Instruction**
1) Integrated lecture and laboratory exercises, discussion, demonstration
2) Small and large group discussion
3) In-class individual and group activities/projects
4) Field trips
5) Guest speakers
6) Auxiliary use of study groups, peer tutoring and/or instructional office hours
7) Instructional slides, video presentations

**Out-of-Class Assignments**
1) Read and comprehend concepts in biology
2) Solve problems of a biological nature
3) Analyze questions or scenarios about biological issues and problems
4) Pre-read laboratory assignments, study for quizzes and to write laboratory reports or complete laboratory worksheets.

**Texts and References**
1) Required: (representative examples):
   a. Krogh, David. *Biology: A Guide to the Natural World*. 5th edition. Benjamin Cummings, 2014.
   b. Biology 2e by Open Stax. Open Stax. 2018. Web Version Last Updated July 2023.
   c. Nette, Kathryn M. *BIO 131 Laboratory Manual*. Cuyamaca College, 2020.
2) Supplemental: Books, journals, course packets as assigned by instructor.

**Exit Skills**
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Outline the methods and activities of scientific inquiry used to solve problems in biology, identify limitations to the types of questions that can be answered scientifically, and apply knowledge gained in the course to assess contemporary problems in biology.
2) Distinguish among statements that describe a hypothesis, a theory or natural law.
3) Determine whether an entity is living based upon a description of its properties.
4) Classify an organism into the appropriate domain and kingdom based upon its characteristics and justify the reasons for placing it there.
5) Explain how the various components of matter can be organized into biological molecules.
6) Compare and contrast the structures, roles and interrelationships of biological molecules including nucleic acids, proteins, carbohydrates and lipids.
7) Given a single stranded DNA molecule, create the complementary strand of the double helix, transcribe one of the strands into RNA, and translate into a peptide.
8) Describe the relationship between structure and function in proteins and the implications of changes in structure on the operation of a cell.
9) Construct a model of a prokaryotic and eukaryotic cell that includes the various sub-cellular structures and describes their inter-relationships and possible origins.
10) Demonstrate a model that describes the chemical composition and architecture of a cell membrane, describe the different mechanisms for molecular movement across the membrane, and predict the flow of molecules across the membrane based on osmolarity on opposite sides of the membrane.
11) Explain how enzymes allow anabolic and catabolic metabolism in a cell to operate in terms of the cell's energy flow.
12) Describe the processes of photosynthesis, glucose oxidation, and fermentation in terms of their energy flow, conversion properties, and their interrelationships.

13) Compare and contrast the functions and mechanisms of mitosis and meiosis in a diploid organism's life cycle.
14) Solve problems that require calculation of the probability of the inheritance of a particular genetic allele for Mendelian and non-Mendelian scenarios.
15) Appraise the evidence for evolution and illustrate the key concepts using an example.
16) Develop hypotheses design experiments, organize, and critically analyze data to show relationships and conclusions. Communicate results of investigations.
17) Utilize typical laboratory microscopes to recognize and explain the significance of the differences between prokaryotic and eukaryotic cells.
18) Describe the relationship between respiration and photosynthesis, producers and consumers and the role of each of these in ecosystems.
19) Compare and contrast the chemical nature and structure of nucleic acids as well as their role in gene expression.
20) Describe the significance of the relationship between structure and function in biological systems.

**Student Learning Outcomes**

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

1) Utilize factual evidence, appropriate terminology, and the tools of scientific inquiry to explain how structure contributes to biological function.
2) Collaborate as a member of a team to use the tools and methods of scientific inquiry to solve problems in biology.
3) Formulate hypotheses, and accurately collect, organize, and analyze experimental data to draw meaningful conclusions about proposed hypotheses.
4) Operate laboratory microscopes to observe and distinguish structures within eukaryotic cells and relate these structures to broader cellular functions and organization.