Lassen Community College Course Outline

BIOL-1 Principles of Molecular and Cellular Biology 4.0 Units

I. Catalog Description

A course in principles of biology, with special emphasis given to molecular and cellular biology. Topics include the chemical basis of life, prokaryotic and eukaryotic cells, structure and function, cell metabolism, cellular communication, classical genetics, molecular genetics, and biotechnology. This course is designed to meet the core requirements for biology and related majors. (This course is the recommended preparation for BIOL 4, BIOL 20, and BIOL 25.) This course has been approved for hybrid (online/traditional) delivery.

Prerequisite(s): Math 60 - Intermediate Algebra or the equivalent multiple measures placement and Chemistry 1A- General Chemistry I

Prerequisite Skills Required:
Before entering this course, the student should be able to:

1. Develop a systematic logical approach to solving a variety of problems
2. Integrate mathematical computational and algebraic skills to solve and graph a variety of linear, exponential and logarithmic equations.
3. Demonstrate a basic understanding of atomic and simple molecular structure.

Transfers to both UC/CSU
General Education Area: A
CSU GE Area: B2 & B3
IGETC GE Area: 5B & 5C
C-ID BIOL 190
51 Hours Lecture, 102 Expected Outside Class Hours, 51 Hours Lab, 204 Total Student Learning Hours
Scheduled: Spring

II. Coding Information

Repeatability: Not Repeatable, Take 1 Time
Grading Option: Graded or Pass/No Pass
Credit Type: Credit - Degree Applicable
TOP Code: 040100

III. Course Objectives

A. Course Student Learning Outcomes

Upon completion of this course the student will be able to:

1. Apply the scientific method by stating a question; researching the topic; determining appropriate tests; performing tests; collecting, analyzing, and presenting data; and finally proposing new questions about the topic.
2. Analyze the relationship between structure and functions of various molecules within living cells
3. Explain the relationship of the structures and functions of various cellular organelles to the metabolic activities of a prokaryotic or eukaryotic cell.
4. Perform both a mendelian and molecular genetics techniques.
5. Perform biological laboratory skills and display habits of good

laboratory practices.

B. Course Objectives

Upon completion of this course the student will be able to:

1. Describe the areas covered by: biology, cytology, anatomy, physiology, microbiology, genetics, and evolution, population biology.
2. Describe the levels of organization (atomic-molecular through ecosystem and the biosphere).
3. Describe characteristics of living organisms.
4. Apply the scientific method.
5. Describe atomic structure and diagram specified atoms from the given atomic number and weight.
6. Describe, define, and illustrate kinds of chemical bonds.
7. Describe the unusual properties of water.
8. Define acid, base, and discuss the meaning of pH.
9. Describe the basic structure and function of carbohydrates, lipids, proteins, and nucleic acids in living cells.
10. Describe the factors affecting the rate of chemical reactions.
11. Define and give examples of enzymes and the substrates upon which they act.
12. Differentiate the several ways that substances move across cell membranes.
13. State the cell theory in its contemporary form.
14. Describe the structure and function of primary organelles found in prokaryotic and eukaryotic cells.
15. Describe the mechanisms of hormonal regulation of cellular activity.
16. Describe photosynthesis including the molecules and energy that enter the light-dependent reaction and the Calvin cycle.
17. Discuss the significance of photosynthesis to life on earth.
18. Describe fermentation and aerobic cellular respiration including what molecules enter and exit each process and their energy relationships.
19. Name the stages and describe the significant events in the processes of cell division (mitosis and cytokinesis) and reduction division (meiosis and cytokinesis). Identify the stages of mitosis, cytokinesis and meiosis and describe the significant events that occur in each stage.
20. Describe Mendel's law of dominance, law of segregation and law of independent assortment and discuss their important to heredity.
21. Perform crosses of various traits using the given organism and analyze their results.
22. Solve genetics problems involving monohybrids, dihybrids, sex-linkage, incomplete dominance, and multiple alleles.
23. Describe the processes of DNA replication, transcription and translation in both a prokaryotic cell and a eukaryotic cell.
24. Describe mechanisms of gene regulation.
25. Describe the lytic and lysogenic cycles of multiplication in viruses.
26. Describe recent advances in recombinant DNA technology.
27. Discuss sources of variation: mutation, recombination, sexual reproduction, etc.

IV. Course Content

The following topics may be included; however, the order of presentation, relative emphasis and the depth of treatment will depend on the preferences on the instructor.

A. Introduction to Biology
   1. Characteristics of Living Things

2. Levels of Organization
3. Science and Scientists and Scientific Inquiry
4. Evolution
    a. Origin of Life
    b. Molecular Evolution
    c. Cellular Evolution

B. Biochemistry
1. Organic Molecules (carbohydrates, lipids, proteins, nucleic acids)

C. Cell Structure
1. Membranes and Transport
2. Organelles - structure and function
3. Prokaryotic versus Eukaryotic Cell structure and function

D. Cellular communication

E. Bioenergetics
1. Laws of Thermodynamics
2. Central Role of ATP

F. Chemical Reactions

G. Enzymes (structure and function)

H. Enzymatic Pathways and Regulation

I. Photosynthesis
1. Cyclic Photosynthesis
2. Non-cyclic Photosynthesis
3. Role in Cycling Elements

J. Metabolism
1. Anaerobic Pathways
2. Aerobic Cellular Respiration

K. Cellular Reproduction
1. Asexual reproduction
2. Sexual reproduction

L. Hereditary Principles
1. Mendelian Genetics
2. Golden Age of Classical Genetics
3. Human Genetics

M. Molecular Genetics
1. Nucleic Acids
2. Protein Synthesis
3. Gene Regulation
4. Human Genome Research

N. Genetic Variation in Nature
1. Sexual Reproduction
2. Mutations
3. Recombination

O. Recombinant DNA Technology
1. Viral Multiplication
2. History of Recombinant Technology
3. Modern Techniques in Genetic Engineering
4. Ethical Issues

Laboratory Content

A. Scientific Inquiry and Experimental Design

B. Introduction to Laboratory Equipment and Procedures

C. Organic Molecules
D. Membrane Function
E. Prokaryotic Cell Structure
F. Eukaryotic Cell Structure
G. Cell Specialization
H. Enzyme Function
I. Cellular Processes – Non-cyclic Photosynthesis
J. Cellular Processes – Fermentation and Aerobic Cellular Respiration
K. Cellular Asexual Reproduction
L. Sexual Reproduction - Life Cycles
M. Classical Genetics
N. Molecular Genetics

V. Assignments

A. Appropriate Readings

Reading assignments, which will be used to enhance the learning process may include, but are not limited to:

1. Standard college level lecture and laboratory texts
2. Scientific journals such as Scientific American and Science
3. Electronic and other archival research on a variety of topics in biology
4. Newspaper articles relevant to current topics in biology

B. Writing Assignments

In order to successfully complete the course, students must demonstrate understanding of course content through writing assignments which may include, but are not limited to:

1. Essay answers to questions on mixed format examinations
2. Detailed scientific report on an experimental monohybrid genetic cross conducted by the student in the laboratory.
3. Written analysis of weekly laboratory exercises in biology.

C. Expected Outside Assignments

Examples of outside assignments may include, but are not limited to:

1. Performance and analysis of an independent experiment in the field of classical genetics.
2. Solution of a series of genetic problems (monohybrid, dihybrid, multiple allele and sex-linked).
3. Reading and writing assignments as specified in the course syllabus.
4. Library and Learning Center: electronic and other archival research on a variety of topics in the field of biology.
5. Read and summarize newspaper articles relevant to current topics in biology.

D. Specific Assignments that Demonstrate Critical Thinking

This course presents many examples of the utilization of critical thinking by scientists for the advancement of scientific knowledge. Examples of assignments that demonstrate critical thinking may include, but are not limited to:

1. Review of periodicals and newspapers
2. Analysis and synthesis of information presented in the text and during lecture
3. Analysis of an experiment in classical genetics
4. Solution of a series of genetics problems

VI. Methods of Evaluation

The first day of class the instructor will provide each student with a written course syllabus indicating the evaluation procedures to be used.

Traditional Classroom Instruction

The formulation of a student grade will be based upon:

A. Performance on mixed-format including essay questions asking students to critically analyze topics discussed in class. Sample essay questions:
   1. Discuss the unique nature of the water molecule and its role in living systems.
   2. Interpret the significant factors provided by non-cyclic photosynthesis as they relate to the survival of living organisms (including ourselves) on this planet.
   3. Compare and contrast the metabolic processes utilized in the production of ATP in prokaryotic and eukaryotic cells.
   4. In humans sickle-cell anemia is caused by a recessive autosomal allele and color blindness is caused by a recessive sex-linked allele. Identify the possible offspring of a couple both heterozygous for sickle-cell anemia and both with normal vision, although the father of each was color-blind.
B. Performance on independent study laboratory exercise in genetics
C. Performance on laboratory exercises and write-ups of those exercises

Hybrid Evaluation:

A combination of traditional classroom and online evaluations will be used, such as (1) All quizzes and exams will be administered during the in person class time. Students will be expected to complete online assignments and activities equivalent to in class assignments and activities for the online portion of the course. Electronic communication, both synchronous and asynchronous (chat/forum) will be evaluated for participation and to maintain effective communication between instructor and students.

VII. Methods of Delivery

Check those delivery methods for which, this course has been separately approved by the Curriculum/Academic Standards Committee.

☒ **Traditional Classroom Delivery** ☐ Correspondence Delivery

☒ **Hybrid Delivery** ☐ Online Delivery

Traditional Classroom Instruction

Methods of instruction may include, but are not limited to:

1. Lecture and computer assisted presentations
2. Computer generated tutorials
3. Laboratory
4. Discussion and problem solving performed in and outside class
5. Homework and extended projects
6. Collaborative projects

Hybrid Delivery

Hybrid modality may involve face to face instruction mixed with online instruction. A minimum of 1/3 of instruction including 100 % of labs will be face to face. The remaining hours will be taught online through a technology platform as adopted by the district.

VIII. Representative Texts and Supplies

Standard college level texts will be required.
Recommended text: T. Rust, *A Guide to Biology Lab*, T. Rust 1983, ISBN: 9780937029015
Required text: Reece, Urry, Cain, Wassernam, Minorsky, Jackson Campbell Biology, 12th Edition, 2021, Pearson Education, ISBN-10: 0135188743 or 13:9780135188743
Required text: In-house, *Principles of Molecular & Cellular Biology Lab Workbook.*

IV. Discipline/s Assignment

Biological Sciences

X. Course Status

Current Status: Active
Original Approval Date: 1/16/1990
Revised By: Crystal Tobola
Curriculum/Academic Standards Committee Revision Date: 12/06/2022