GAVILAN COLLEGE
5055 Santa Teresa Blvd
Gilroy, CA 95023

Course Outline

COURSE: BIO 1 DIVISION: 10 ALSO LISTED AS:

TERM EFFECTIVE: Spring 2022 CURRICULUM APPROVAL DATE: 05/10/2022

SHORT TITLE: CELL AND MOLECULAR BIOLOGY

LONG TITLE: Cell and Molecular Biology

Units	Number of Weeks	Type	Contact Hours/Week	Total Contact Hours
5	18	Lecture:	3	54
		Lab:	6	108
		Other:	0	0
		Total:	9	162

COURSE DESCRIPTION:

This is the first course in a two-semester sequence intended for life science majors with a strong cell respiration, photosynthesis, cell life cycle and its emphasis on biochemistry, cell biology, and genetics. Topics include: cellular chemistry; biological molecules; structure and function of prokaryotic and eukaryotic cells; cell transport; bioenergetics and enzymes; cell metabolism including respiration and photosynthesis; cellular communication; cell reproduction and its controls; Mendelian and non- Mendelian genetics; molecular genetics; DNA structure and function; gene expression; biotechnology; origin and evolution of life and molecular evolution; and scientific inquiry. (C-ID: BIO 190) PREREQUISITES: BIO 10, BIO 12, or ENVS 1 with a grade of 'C' or better, or AP or Honors Biology with a grade of 'B' or better completed within the last five years; CHEM 30A or high school chemistry with a grade of 'B' or better completed within the last five years, and MATH 240 or Intermediate Algebra or equivalent with a grade of 'C' or better. High school-level reading and writing skills are strongly recommended.

PREREQUISITES:

(Completion of BIO 10, as UG, with a grade of C or better.
OR
Completion of BIO 12, as UG, with a grade of C or better.
OR
Completion of ES 1, as UG, with a grade of C or better.)
OR
Completion of ENVS 1, as UG, with a grade of C or better.
AND Completion of CHEM 30A, as UG, with a grade of C or better.
AND Completion of CHEM 1A, as UG, with a grade of C or better.
AND (Completion of MATH 233, as UG, with a grade of C or better.
OR
Completion of MATH 233B, as UG, with a grade of C or better.
OR
Completion of MATH 235, as UG, with a grade of C or better.
OR
Completion of MATH 240, as UG, with a grade of C or better.
OR
Completion of MATH 242, as UG, with a grade of C or better.
OR
Completion of MATH 3, as UG, with a grade of C or better.
OR
Completion of MATH 5, as UG, with a grade of C or better.
OR
Completion of MATH 6, as UG, with a grade of C or better.
OR
Completion of MATH 7, as UG, with a grade of C or better.
OR
Completion of MATH 12, as UG, with a grade of C or better.
OR
Completion of MATH 14, as UG, with a grade of C or better.
OR
Completion of MATH 8A, as UG, with a grade of C or better.
OR
Completion of MATH 8B, as UG, with a grade of C or better.
OR
Completion of MATH 1A, as UG, with a grade of C or better.
OR
Completion of MATH 1B, as UG, with a grade of C or better.
OR
Completion of MATH 1C, as UG, with a grade of C or better.
OR
Score of 33 on Intermediate Algebra
OR
Score of 13 on Pre-Calculus
OR
Score of 2600 on MM CCCApply Math
OR

Score of 2600 on MM Placement Tool Math
OR
Score of 2600 on Accuplacer Math)

COREQUISITES:

CREDIT STATUS: D - Credit - Degree Applicable

GRADING MODES
L - Standard Letter Grade

REPEATABILITY: N - Course may not be repeated

SCHEDULE TYPES:
02 - Lecture and/or discussion
03 - Lecture/Laboratory
04 - Laboratory/Studio/Activity
04B - Laboratory - LEH 0.75
05 - Hybrid
71 - Dist. Ed Internet Simultaneous
72 - Dist. Ed Internet Delayed
73 - Dist. Ed Internet Delayed LAB
73B - Dist. Ed Internet LAB-LEH 0.75

STUDENT LEARNING OUTCOMES:
By the end of this course, a student should:
1. Evaluate the roles of the major biological molecules in the structure and function of cells.
2. Examine how cells capture, store, and process energy.
3. Compare and contrast the two forms of eukaryotic cell division, mitosis and meiosis.
4. Analyze how genetic information is stored, replicated, and expressed by cells.
5. Apply the process of scientific inquiry and experimental design to the study of biological concepts.

COURSE OBJECTIVES:
By the end of this course, a student should:
1. Identify and describe biological molecules and cell structures and explain their functions.
2. Compare and contrast cellular processes and interactions between prokaryotes and eukaryotes (including metabolism, reproduction, communication).
3. Apply the principles of classical and molecular genetics to solve problems in genetics or biotechnology.
4. Relate evolutionary processes to the origin and evolution of cells.
5. Explain how DNA replicates and transmits genetic information within organisms.
6. Apply the processes of scientific inquiry and experimental design to the study of biological concepts.
7. Acquire, read, evaluate, apply and cite scientific literature.
8. Compose reports that communicate the background and significance, experimental design, results, and analysis of laboratory experiments.

CONTENT, STUDENT PERFORMANCE OBJECTIVES, OUT-OF-CLASS ASSIGNMENTS

Curriculum Approval Date: 05/10/2022

LECTURE CONTENT:

Major Topics

1. Scientific inquiry and biological organization
2. Chemistry and biological molecules
3. Cell structure and function
4. Membrane structure and function
5. Bioenergetics and enzymes
6. Cellular metabolism (respiration, fermentation, photosynthesis)
7. Cell communication
8. Cellular and organismal reproduction and its controls
9. Mendelian and non-Mendelian genetics
10. DNA structure and function
11. Gene expression and its regulation
12. Biotechnology
13. Viruses
14. Origin and evolution of cellular life and molecular evolution
15. Embryonic development
16. Organ systems and homeostasis

3 LECTURE HOURS

CONTENT: Scientific inquiry and biological organization

STUDENT PERFORMANCE - the student will be able to:

- Define a hypothesis and compare inductive and deductive reasoning.
- List the levels of organization from atom to ecosystem and note how the levels relate to each other.
- Describe and distinguish between the three domains of life. List examples of each domain.
- Describe properties that are common to all life.
- Describe the process of natural selection.

3 LECTURE HOURS

CONTENT: Chemistry and biological molecules

STUDENT PERFORMANCE - the student will be able to:

- Define the atomic number and mass number of an atom.
- Distinguish among nonpolar covalent, polar covalent, and ionic bonds, noting their relative strengths and functions.
- Describe the structure of the atom.
- Identify which elements are most common in living matter.
- Describe the emergent properties of water.
- Describe the relationship between acids, bases, and buffers.
- Define solute, solvent, and solution.
- Describe the properties, structures, and functions of the four biomolecules.

3 LECTURE HOURS

CONTENT: Cell structure and function

STUDENT PERFORMANCE - the student will be able to:

- Explain why there are upper limits to cell size.
- Distinguish between prokaryotic and eukaryotic cells.
- Explain why compartmentalization is important in eukaryotic cells.
- Compare the structures of plant and animal cells. Note the function of each cell part.

3 LECTURE HOURS
CONTENT: Membrane structure and function
STUDENT PERFORMANCE - the student will be able to:
- Describe the structures and functions of the plasma membrane.
- Identify, compare, and contrast the different processes of cell transport.
- Explain how membranes help organize the chemical activities of a cell.
- Relate the structure of phospholipid molecules to the structure and properties of cell membranes.
- Describe the fluid mosaic structure of cell membranes.
- Describe the diverse functions of membrane proteins.
- Describe the process of passive transport. Explain why osmosis is the passive transport of water.
- Distinguish between hypertonic, hypotonic, and isotonic solutions.
- Explain how plant and animal cells change when placed into a hypertonic or hypotonic solution.
- Compare the processes of facilitated diffusion and active transport.
3 LECTURE HOURS
CONTENT: Bioenergetics and enzymes
STUDENT PERFORMANCE - the student will be able to:
- Define and compare kinetic energy, potential energy, chemical energy, and heat.
- Define and compare endergonic and exergonic reactions. Explain how cells use these reactions to survive.
- Explain how ATP functions as an energy shuttle.
- Explain how enzymes speed up chemical reactions.
- Describe the structure of an enzyme-substrate interaction.
- Explain how the cellular environment affects enzyme activity.
- Explain how competitive and noncompetitive inhibitors alter an enzyme's activity.
6 LECTURE HOURS
CONTENT: Cellular metabolism (respiration, fermentation, photosynthesis)
STUDENT PERFORMANCE - the student will be able to:
- Summarize the overall equation for cell respiration and photosynthesis.
- Identify the different stages of each process and describe where they happen in the cell.
3 LECTURE HOURS
CONTENT: Cell communication
STUDENT PERFORMANCE - the student will be able to:
- Identify the components of a cell signaling pathway.
- Describe the components and functions of a typical cell signaling pathway.
- Describe the steps of G-protein-coupled receptor and receptor tyrosine kinase pathways.
- Identify examples of prokaryotic cell signaling pathways.

3 LECTURE HOURS

CONTENT: Cellular and organismal reproduction and its controls

STUDENT PERFORMANCE - the student will be able to:

- Describe the major events of the G1, S, and G2 stages of interphase, including how long each stage typically takes.
- Describe the major events of the five stages of mitosis, and cytokinesis, including how long each stage typically takes.
- Describe what a sister chromatid is.
- Describe the process of binary fission.
- Identify organisms that use an "intermediate" form of mitosis, and compare and contrast this process with mitosis.
- Explain the three cell cycle checkpoints, including what the cell is checking for at each checkpoint, and the role of cyclins and Cdks.
- Describe the experiment involving fusion of cells at different stages of the cell cycle.
- Describe three other requirements for cells to keep going through the cell cycle.

5 LECTURE HOURS

CONTENT: Mendelian and non-Mendelian genetics

STUDENT PERFORMANCE - the student will be able to:

- Compare and contrast sexual and asexual reproduction.
- Identify the number of chromosomes in a somatic human cell, and a human gamete.
- Identify other examples of sexual life cycles.
- Draw and walk through each step of meiosis I and II.
- Define the terms synapsis, crossing over and chiasma.
- Explain how meiosis and sexual reproduction are sources of genetic variation.
- Name and describe Mendel?s two laws of inheritance.
- Explain how Punnett squares recapitulate the events of meiosis.
- Apply the sum rule and the product rule when calculating probabilities.
- Explain how these non-Mendelian modes of inheritance work: incomplete dominance; codominance; multiple alleles (specifically the ABO blood group).
- Solve genetics problems involving Mendelian and non-Mendelian modes of inheritance.
- Analyze human pedigrees to determine individual genotypes and modes of inheritance for a given trait.

5 LECTURE HOURS

CONTENT: DNA structure and function

STUDENT PERFORMANCE - the student will be able to:

- Explain the Griffith experiment and its significance in advancing our understanding of DNA.
- Explain the Hershey-Chase "blender" experiment and its significance in advancing our understanding of DNA.
- Describe the significance of the work of Franklin, Watson, and Crick in advancing our understanding of DNA.
- Describe, in detail, the structure of the DNA double helix.
- Explain the Meselson-Stahl experiment and its significance in advancing our understanding of DNA replication.
- Describe the five major steps of DNA replication.
- Identify the enzymes required for DNA replication.
- Describe what comprises a nucleosome.

HOMEWORK: read Ch. 14 and study lecture notes

3 LECTURE HOURS
CONTENT: Gene expression and its regulation
STUDENT PERFORMANCE - the student will be able to:
- Describe the central dogma of molecular biology.
- Define the term gene expression.
- Describe the three major steps of transcription.
- Identify and describe the three pre-mRNA processing events.
- Describe the three major steps of translation.
- Describe what happens during translation to proteins that contain a signal sequence.
- Identify and describe the post translational modifications that happen to most proteins.
- Identify and describe the three types of point mutations.
- Describe a frameshift mutation.
- Identify possible effects of any of these kinds of mutations.
3 LECTURE HOURS
CONTENT: Biotechnology, Viruses
STUDENT PERFORMANCE - the student will be able to:
- Describe the steps involved in cloning a gene of interest into a plasmid.
- Describe the similarities and differences between a genomic and cDNA library.
- Explain how PCR works.
- Explain how gel electrophoresis works.
- Explain how DNA sequencing works.
- Explain how CRISPR-Cas9 works.
- Describe how retroviral vectors are used to create induced pluripotent stem (iPS) cells.
- Identify applications of forensic science.
- Identify potential benefits and drawbacks of GMOs.
3 LECTURE HOURS
CONTENT: Origin and evolution of cellular life and molecular evolution
STUDENT PERFORMANCE - the student will be able to:
- Distinguish between the ideas on the development of life on Earth from Aristotle, the Old Testament, Linnaeus, Cuvier, Hutton and Lyell, and Lamarck.
- Describe the observations and claims Darwin made from his 5-year voyage.
- Explain the process of natural selection.
- Describe the five lines of evidence that support the theory of evolution.
- Identify misconceptions about evolution,and explain why they are misconceptions.
- Define phylogeny, systematics, taxonomy, and a phylogenetic tree.
- Distinguish between the terms homologous and analogous when they are used to describe two structures.
- Describe the difference between orthologues and paralogues.
- Explain how can genes be used as a molecular clock.
- Distinguish between shared ancestral characters and shared derived characters.
3 LECTURE HOURS
CONTENT: Embryonic development
STUDENT PERFORMANCE - the student will be able to:
- Describe the process of development from the zygotic through embryonic stages.

3 LECTURE HOURS

CONTENT: Organ systems and homeostasis

STUDENT PERFORMANCE - the student will be able to:

- Describe the functions and components of the major animal organ systems.
- Explain why maintaining homeostasis is essential for multicellular organisms.

2 LECTURE HOURS

Final Exam

LAB CONTENT:

Major Topics

1. Use of instruments and techniques common to cell and molecular biology and biotechnology, including microscopy, chromatography, spectrophotometry, electrophoresis, PCR, cell culture, CO2 monitoring, RFLP analysis, and bacterial transformation.

2. Examination of the properties of macromolecules using colorimetric assays.

3. Examination of membrane properties, and cell structure in prokaryotes and eukaryotes.

4. Examination of the properties of enzymes and enzyme kinetics.

5. Studies relating to photosynthesis, including photosynthetic rates, spectral properties of pigment extracts, and the biochemistry of the light reactions and Calvin cycle.

6. Studies relating aerobic cellular respiration and fermentation, including temperature effects on metabolic rate in poikilotherms and endothermic homeotherms, enzymatic requirements of intermediary metabolism.

7. Studies relating to the molecular genetics and the control of metabolism.

8. Activities that involve problem-solving and experience with Mendelian and non-Mendelian traits, probability, pedigrees, and linkage analysis.

9. Use of computers to access genetic databases (e.g., GenBank) to understand gene mapping, evolution, and human variation.

10. Use of chicken embryos to study embryology and development.

11. Use of histological sections to study microscopic anatomy of tissues and organs.

12. Experimental design, data recording, and data analysis are used throughout the laboratory activities.

6 LAB HOURS

CONTENT: Safety procedures in the lab; the microscope (#1. 11)

STUDENT PERFORMANCE - the student will be able to:

- Describe lab safety procedures
- Demonstrate use of microscope

6 LAB HOURS

CONTENT: pH and the calculation of hydrogen and hydronium ions in solution (#2)

STUDENT PERFORMANCE - the student will be able to:

- Measure pH of various liquids
- Calculate the concentration of hydrogen and hydronium ions at various pH levels

6 LAB HOURS

CONTENT: Cells (#1, #3, #11)

STUDENT PERFORMANCE - the student will be able to:

- Use the microscope to identify various types of cells
- Draw and label cell types
- Identify, draw and describe structures of protozoans and cyanobacteria using the microscope

6 LAB HOURS

CONTENT: Staining specimens and examining through the microscope (#1, #3, #11)

STUDENT PERFORMANCE - the student will be able to:

- Be able to stain specimens and view using the microscope

6 LAB HOURS

CONTENT: Enzymes (#1, #4)

STUDENT PERFORMANCE - the student will be able to:

- Explain how pH, temperature, enzyme concentration, and substrate concentration affect the activity of an enzyme

6 LAB HOURS

CONTENT: Separation of pigments using paper chromatography, absorbance spectrum of plant pigments (#1, #5)

STUDENT PERFORMANCE - the student will be able to:

- Separate plant pigments using paper chromatography
- Determine the absorbance spectrum of the pigments separated

6 LAB HOURS

CONTENT: Cell respiration and fermentation (#6, #7)

STUDENT PERFORMANCE- the student will be able to:

- Identify experimentally the best sugar for fermentation in yeast
- Identify requirements for fermentation in yeast
- Identify temperature and enzyme requirements for cell respiration
- Describe the role of molecular genetics in metabolism.

6 LAB HOURS

CONTENT: Researching a paper and cultivating reliable information from the Internet (#9)

STUDENT PERFORMANCE - the student will be able to:

- Research a topic using resources from the Internet
- Use the computer and search the internet for resources
- Be able to distinguish between a reliable, and unreliable resource found on the web
- Explain how resources should be cited in a scientific paper
- Describe the various parts of a scientific paper

6 LAB HOURS

CONTENT: Preparing and conducting a scientific experiment (#12)

STUDENT PERFORMANCE - the student will be able to:

- Explain how to conduct a scientific experiment
- Prepare a scientific experiment

18 LAB HOURS

CONTENT: Drosophila melanogaster crosses (#8, #12)

STUDENT PERFORMANCE - the student will be able to:

- Describe the difference between male and female fruit flies
- Describe properties of model organisms
- Identify eye color and wing morphology in fruit flies
- Perform a cross between fruit flies of differing genotypes
- Remove parental fruit flies from crosses using Fly-Nap
- Count the progeny of the F1 cross
- Analyze data from the fruit fly crosses, performing a chi-squared test

6 LAB HOURS

CONTENT: Single-gene human traits (#8)

STUDENT PERFORMANCE - the student will be able to:

- List examples of single-gene human traits
- Solve genetics problems involving inheritance of single-gene human traits
- Perform Hardy-Weinberg calculations on hypothetical populations

6 LAB HOURS
CONTENT: Pedigree and linkage analysis (#8)
STUDENT PERFORMANCE - the student will be able to:
- Analyze pedigrees to determine modes of inheritance
- Analyze pedigrees to determine probabilities of inheritance
- Analyze crosses involving linked genes
6 LAB HOURS
CONTENT: Histology (#11)
STUDENT PERFORMANCE - the student will be able to:
- Identify the major tissue types and organs
6 LAB HOURS
CONTENT: Embryology and development (#10)
STUDENT PERFORMANCE - the student will be able to:
- Identify major components of animal embryos
- Identify various stages of embryonic development
6 LAB HOURS
CONTENT: Genetic basis of evolution (#1, #7, #9)
STUDENT PERFORMANCE - the student will be able to:
- Describe how DNA and protein sequence is used to establish evolutionary relationships among species
6 LAB HOURS
CONTENT: Lab Practicals (#12)
STUDENT PERFORMANCE - the student will be able to:
- Review material
- Complete and submit research paper

METHODS OF INSTRUCTION:
Lecture and laboratory, with use of computer animations, video, PowerPoint presentations, and the Internet.

OUT OF CLASS ASSIGNMENTS:
Required Outside Hours 20
Assignment Description
A paper (APA format) on the Drosophila genetics lab. The paper will include an abstract, introduction, materials and methods, results, discussion, and cited references.
Required Outside Hours 48
Assignment Description
Homework assignments and genetics problem sets
Required Outside Hours 40
Assignment Description
Lab write-ups

METHODS OF EVALUATION:
Objective examinations
Evaluation Percent 50
Evaluation Description
Percent range of total grade: 30% to 70%
Multiple Choice
True/False
Completion
Free Response

Writing assignments
Evaluation Percent 25
Evaluation Description
Percent range of total grade: 20% to 30%
Lab Reports
Other Papers

Problem-solving assignments
Evaluation Percent 20
Evaluation Description
Percent range of total grade: 10% to 30%
Homework
Lab Reports
Quizzes

Skill demonstrations
Evaluation Percent 5
Evaluation Description
Percent range of total grade: 2% to 5%
Class Performance
Field Work
Performance Exams
Demonstrations of lab skills, e.g. microscope use

REPRESENTATIVE TEXTBOOKS:

Biology 2e, Mary Ann Clark, Jung Choi, Matthew Douglas, OpenStax, 2018.

ISBN: 978-1-947172-52-4

Rationale: Biology 2e is an open educational resource (OER) and also zero textbook cost (ZTC). It is comparable to the prevailing textbooks used for this course (Campbell Biology, Biological Science, Life: The Science of Biology).

12 Grade Verified by: MS Wor

REQUIRED OTHER TEXTBOOKS OR MATERIALS:

Kurushima. Cell and Molecular Biology Lab Manual, 2018 edition.

RECOMMENDED MATERIALS OR TEXTBOOKS:

Campbell Biology 12th ed., Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Pearson, 2021.

ISBN: ISBN: 9780135188743

17 Grade Verified by: D. Young

ARTICULATION and CERTIFICATE INFORMATION

Associate Degree:

GAV B2, effective 201330

GAV B3, effective 201330

CSU GE:

CSU B2, effective 201330

CSU B3, effective 201330

IGETC:

IGETC 5B, effective 201330

IGETC 5C, effective 201330

CSU TRANSFER:

Transferable CSU, effective 201330

UC TRANSFER:

Transferable UC, effective 201330

SUPPLEMENTAL DATA:

Basic Skills: N
Classification: Y
Noncredit Category: Y
Cooperative Education:
Program Status: 1 Program Applicable
Special Class Status: N
CAN: BIOL2
CAN Sequence: BIOL SEQ A
CSU Crosswalk Course Department: BIO
CSU Crosswalk Course Number: 190
Prior to College Level: Y
Non Credit Enhanced Funding: N
Funding Agency Code: Y
In-Service: N
Occupational Course: E
Maximum Hours:
Minimum Hours:
Course Control Number: CCC000597759
Sports/Physical Education Course: N
Taxonomy of Program: 040100