

Biology w/lab Honors

Course Description:

This course provides a more rigorous version of our college preparatory course. Through investigation and activities, students gain firsthand experience with such learning skills and processes as observing, classifying, identifying, measuring, inferring, hypothesizing, interpreting, and predicting. Students will develop an understanding of the diversity of life and the interdependence of all organisms. Students will complete biology labs relevant to the topics studied and complete lab reports. The labs are designed to promote technical lab competence, utilize the scientific process of research and reporting, and teach and reinforce scientific concepts. Students will complete a semester term paper on a chosen topic along with additional writing assignments.

Course Goals/Major Outcomes:

Students will work towards mastering the California State Biology/Life Science Content Standards. Student understanding of the standards will be measured by teachers, working collaboratively, to consider a multifaceted view of what constitutes a mature understanding of concepts. Upon completion of this course students will understand that:

1. The fundamental processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.
2. Mutation and sexual reproduction lead to genetic variation in a population.
3. A multicellular organism develops from a singly zygote, and its phenotype depends on its genotype, which is established at fertilization.
4. Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of acids in proteins characteristic of that organism.
5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.
6. Stability in an ecosystem is a balance between competing effects.
7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time.
8. Evolution is the result of genetic changes that occur in constantly changing environments.
9. As a result of the coordinated structures and functions of organ systems, the internal environment of the organism remains relatively stable despite changes in the outside environment.
10. Organisms have a variety of mechanisms to combat disease.
11. Scientific progress is made by asking meaningful questions and conducting careful investigations.

Students will also learn laboratory techniques related to:

1. Dispensing chemicals
2. Dropping chemicals
3. Heating liquids in test tubes
4. Obtaining accurate measurements using volume measurement equipment
5. Using filtration equipment

6. Heating methods for small-scale techniques
7. Using a field microscope
8. Laboratory safety procedures

Course Objectives:

The course objectives include mastery of and lab work featuring the following topics:

- *Cell Biology
- *Genetics
- *Ecology
- *Evolution
- *Physiology
- *Investigation and Experimentation

Course Outline:

I. The Study of Life

A. The Science of Biology

1. Biology today
2. Science and the Search for Knowledge
3. Studying Biology

Lab: The Scientific Method

- Objectives: 1. To systematically observe some properties of unknown substances
2. To use the Scientific Method to hypothesize about and identify unknown substances

B. Discovering Life

1. What is Life?
2. Basic chemistry
3. Molecules of Life

Lab: Macromolecules of Life

Objective: To introduce the basic molecules of life and test for their presence

C. Cells

1. Cell Boundaries
2. Membrane Structure
3. Inside the Cell
4. Eukaryotes and Prokaryotes
5. Homeostasis

D. The Living Cell

1. Cell communication
2. Movement of substances in and out of cells

Lab: Cell Wall Transport

Objective: To understand the transport of molecules across cell membranes

- E. Energy and Life
 - 1. Cells and Chemistry
 - 2. Cells and Energy
 - 3. Photosynthesis
 - 4. Cellular Respiration

Lab: Photosynthesis and Respiration

Objectives: 1. To observe the effect of photosynthesis in capturing and storing energy from the sun.
2. To observe the effect of respiration in the production of energy, and
3. To understand how photosynthesis and respiration are complementary processes.

II. Continuity of Life

- A. Cell Reproduction
 - 1. Chromosomes
 - 2. Mitosis and Cell Division
 - 3. Meiosis
- B. Genetics and Inheritance
 - 1. Gregor Mendel
 - 2. Patterns of Inheritance
 - 3. Human Genetic Disorders

Lab: Phenotype and Genotype

Objective: 1. To understand phenotype and genotype
2. To understand why one has certain characteristics

- C. How Genes Work
 - 1. DNA
 - 2. Proteins
 - 3. Gene Expression

Lab: DNA and Protein Synthesis and Extraction of DNA

Objective: 1. To introduce the structure of the DNA molecule and how it functions
2. To model the globin B molecule
3. To extract and observe the characteristics of DNA

- D. Gene Technology
 - 1. Revolutions in Genetics
 - 2. Transforming Agriculture
 - 3. Advances in Medicine

Lab: Plant Genetics

- Objective: 1. To understand the genetic information that can be inferred from the phenotype of seeds
2. To learn how to subject the data from observations to statistical analysis for validity

E. Evolution and Natural Selection

1. Charles Darwin
2. Evidence for Evolution
3. Natural Selection
4. Origins of Life
5. Early Life in the Sea
6. Transition to Land
7. Early vertebrates
8. Primates
9. The First Humans
10. Evolution of Behavior

Lab: Primate Characteristics

- Objectives: 1. To examine the characteristics of primates
2. To compare the anatomy and capabilities of primates

III. The Environment

A. Ecosystems

1. Definition of an ecosystem
2. Kinds and cycles of ecosystems

Lab: The Macro Biome

- Objectives: 1. To observe and count the flora and fauna in two square meters of a defined ecosystem and hypothesize their interrelationships
2. To dissect an owl pellet and identify the variety of prey in the owl's feeding range.

Lab: The Micro Biome

- Objectives: 1. To observe and identify the organisms found in bean water
2. To observe and identify the organisms found in a pond or stream
3. To observe if each organism is motile or sessile
4. To identify each organism as a producer or a consumer
5. To hypothesize the relationship between producers and consumers

B. Change within an Ecosystem

C. Identifying and Solving Environmental Problems

IV. Diversity of Life

A. Classifying Living Things

1. Organizing Life

2. Six Kingdoms

Lab: Classification of Species

- Objectives: 1. To understand the concept of the classification of species
2. To practice using dichotomous keys for classification

B. Bacteria and Viruses

Lab: Microbes Everywhere

- Objective: To demonstrate the growth and characteristics of microorganisms

Lab: Conditions to Grow Molds

- Objectives: 1. To hypothesize the conditions that a bread mold needs for growth
2. To determine if bread mold can use a variety of food sources

C. Protists

1. Definition and Diversity of Protists
2. Diseases Causes by Protists

D. Fungi and Plants

Lab: Fungi and Seeds

- Objectives: 1. To study the structure of fungi
2. To study the interactions among fungi, bacteria, and plants

D. Plant Form and Function

1. The Plant Body
2. How Plants Function
3. Reproduction in Flowering Plants
4. Uses of Plants
5. Growing Plants

Lab: Plant Structures

- Objectives: 1. To examine the structures of roots and identify their key parts
2. To examine the structures of stems and identify their key parts
3. To observe the effect of the transport the liquids in stems

Lab: Plant Reproduction

- Objectives: 1. To observe the structure of a flower and identify the functions of flower parts
2. To observe the parts of a fruit and identify the parts important to reproduction

V. **The Animal Kingdom**

- A. Adaptation to Land
- B. Animal Diversity
- C. Arthropods

- D. Fishes and Amphibians
- E. Reptiles, Birds, and Mammals

Lab: Comparing Arthropods

- Objectives:
1. To identify the common and differentiating characteristics of a spider, a crayfish and a grasshopper
 2. To determine which characteristics are phylum characteristics
 3. To determine which characteristics are class characteristics
 4. To construct a dichotomous taxonomic key to distinguish classes of Arthropoda

Lab: Functions of Bones

- Objectives:
1. To hypothesize which bones will be more dense, those of birds or of mammals
 2. To calculate the densities of bird and mammal bones
 3. To explain the reason for differences in the densities of bird and mammal bones

VI. Human Life

- A. Skin
- B. Bones
- C. Muscles
- D. The Nervous System
- E. The Sense Organs
- F. The Circulatory System
- G. The Respiratory System
- H. The Immune System
- I. Digestion and Excretion
- J. Reproduction and Development

Lab: Homeostasis

- Objectives:
1. To observe how the human body responds to changes detected in the external environment to maintain homeostasis.
 2. To identify the location of some of the body's receptors that detect changes in the external environment

Lab: Human Behavior

- Objectives:
1. To hypothesize different behavior for different groups of subjects
 2. To observe, record, and analyze observations of human behavior
 3. To identify instinctive versus learned behavior

Lab: Muscle Fatigue

- Objective:
1. To observe how fatigue affects the number of repetitions of an exercise on can accomplish
 2. To hypothesize how this relates to muscle function

Lab: Chemoreceptors

Objectives: 1. To map the locations of the chemoreceptors in the mouth
2. To demonstrate the interaction of chemoreceptors for taste and smell

Lab: Respiration

Objectives: 1. To measure the resting breathing rate
2. To estimate the amount of air inhaled per minute

Lab: Spread of Contagion

Objectives: To demonstrate the ease of spread of contagion

Key Assignments:

In addition to chapter readings, assignments, quizzes, and tests, students will complete the following:

1. Students will complete all 25 labs presented above. All questions that are presented in the laboratory manuals must be completed and a thorough write up of each of the labs must be submitted and retained in the student's portfolio.
2. Research Projects: Students will complete one research project each semester on a biology topic of choice related to their units of study. The instructor must approve the topic in advance. Each report must have a least three resources. An outline, bibliography, and all rough drafts will be submitted for review. The paper must be 8-10 pages in length and utilize MLA format.
3. Current Events Articles: Students will read and summarize two current events articles each semester related to biology topics.
4. Students will research one occupation related to biology and prepare a report indicting the nature of the job, the training required, typical salary and benefits associated with the job, and the current job market.
5. Students will research one Bay Area biotechnology company and prepare a report describing the company, i.e.: size, when and how started, by whom, what products are being produced, and how the company is combining biology and technology.

Curriculum:

Holt Biology, Visualizing Life: Holt, Rinehart, and Winston 1998

Glencoe Biology, Dynamics of Life, Glencoe-McGraw Hill

Laboratory Manual and Kit:

At Home Science, Inc: Biology Kit 1

Instructional Methods and/or Strategies:

Students will be expected to develop and present work samples described under the key assignments section as well as those required in the textbook/curriculum used. Students will work independently through the text as a primary resource. In order to support this process teachers will provide each student:

- *Opportunities to discuss and define complex issues orally or via email
- *Modeling of activities and expected outcomes
- *A variety of print and non-print resources
- *Modeling of study strategies appropriate for different learning styles
- *Discussions around points of view
- *Opportunities to summarize, analyze, compare/contrast, describe, classify, and persuade
- *Opportunities for practice in preparation for presentations

Assessment Methods and/or Tools:

A variety of assessment tools will be used. Written work, as described above, will be corrected in collaboration between the student, teacher, and parent. Assessment tools include but are not limited to:

- *Standardized tests, including STAR
- *Criterion based tests
- *Portfolio assessments
- *Student Journals
- *Teacher observation
- *Performance assessments using cameras and recorders
- *Student self-evaluation
- *Surveys and questionnaires
- *Written work, quizzes, and final exams must be completed at 75% accuracy rate to receive credit

This course was developed as an honors course to give student's interested in taking a more challenging college preparatory course, particularly those students who are interested in advanced life sciences. This course includes a significant number of laboratory assignments as well as additional written essays designed to help the student focus on the possible applications of the skills learned.