FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

HONORS BIOLOGY

DATE: May 2009 **SUBJECT AREA: Life Science**

PROPOSED GRADE LEVELS: 9th and 10th **COURSE LENGTH: 1 Year**

GRADING: A -F **NUMBER OF CREDITS: 5 per Semester**

PREREQUISITES: Grade of B or above in Physical Earth Science and Algebra 1

COURSE DESCRIPTION:

Honors Biology is a rigorous, college-prep, laboratory science class that provides a foundation in biology for the college bound science major. This course is designed to prepare students for success in college level science courses. Honors Biology progresses at a rapid rate, covers more depth and has more application expectations than Biology. In Honors Biology students will be required to complete a research component pertaining to biology. Students will participate in topics covering cells, chemistry, energy, photosynthesis, cell division, genetics, ecology, taxonomy, physiology, and evolution and bioethics. Modern advances in cellular biology and biochemistry form the basis for the "inquiry into life" covered by this course. Students are asked to form conclusions on the basis of their own observations obtained in lab work. Elements of critical thinking are required of students throughout the course. This course meets university laboratory science requirements and is recommended for students considering taking AP Biology, AP Chemistry, or other AP science course.

GENERAL GOALS/PURPOSES:

- To provide students with a working knowledge and understanding of biology so they will be successful in rigorous college level biology courses.
- Students will use hands-on experiences to develop scientific models and use their models to predict physical behavior.
- Students will discover scientific concepts and apply them to more complex problems.
- Students will be able to organize data, analyze it, and arrive at a logical conclusion.
- Students will develop critical thinking skills that assist in interpreting the natural environment.
- Students will develop an understanding for the important role biology makes in their personal and professional lives, make informed decisions involving science and technology, and develop a lifelong awareness of the limitations of science and technology.
- Students will develop abilities to analyze data through technological means (i.e.: probeware and computers).

STUDENT READING COMPONENT:

The text for this course is ***Biology: Principles and Explorations***, published by Holt, Rinehart and Winston (2001). Reading and interpreting text material and/or lab directions are daily components of this class. Students will read and interpret current events and their effects on society.

STUDENT WRITING COMPONENT:

Students will be expected to write complete and grammatically correct sentences to answer questions regarding the text. They will follow a prescribed format to write lab papers. Some assessments will require short essay answers. There will be at least one research paper required done during the course period.

STUDENT ORAL COMPONENT:

Students will be expected to participate in class discussions. Periodically, they will present biological concepts to the class while utilizing the whiteboard, PowerPoint or video to enhance their delivery.

DETAILED UNITS OF INSTRUCTION:

As students become actively involved in exploring biological principles and concepts within each unit, the timeline will be adjusted to allow for student activities and projects. While all of the California State Standards will be met, timelines are flexible:

> The learning of science is an ongoing process. As such, Honors Biology will build on the conceptual foundations established by previous science courses.
> Students that show an aptitude for science should be encouraged to participate in research based science projects and enter them into local science fairs. These projects will not only strengthen student understanding of science, but also open career and scholarship opportunities for them.
> Note: These units are taken directly from the California State Standards. The state's lettering and numbering system has been incorporated into this outline.
> Letters marked with an * are currently not tested by the state but are considered to be important aspects of biology and will be covered in Honors Biology. Teachers can use their discretion in these areas.

Semester 1

Unit I – Cell Chemistry - Chapter 2

California Content Standard 1h

- Covers basic organic molecules in a cell
- Basic macromolecules proteins, lipids, carbohydrates, nucleic acids
- Use and function in cells
- Cell physiology

Unit II – Structure of Cells and Their Environment – Chapters 3, 4

California Content Standards 1a, 1c, 1e, and 1j

- Basic structure and function of plant and animal cells
- Reaction to environment with passive and active transport of cells
- Comparison of plant, animal, protista, bacterial cells
- Compare and contrast viruses and cells

Unit III – Enzymes and Energy – Ch. 5

California Content Standard 1b

- How reactions occur inside the cell
- How energy is used an processed
- Pre-photosynthesis and cell respiration concepts

Unit IV – Cell Respiration – Ch. 5

California Content Standard 1g and 1i

- Animal cells obtain and use energy, ATP
- Plant cells obtain and use energy, ATP
- How cell respiration occurs in mitochondria
- Function and anatomy of mitochondria
- Chemiosmotic gradients in mitochondria

Unit V – Plants & Photosynthesis – Ch. 5, 24, 26

California Content Standard 1f

- Structure of plants
- Phylogeny of plants
- How plants harvest energy from the sun, energy transfer mechanism
- Anatomy and function of chloroplasts

Unit VI – DNA/Chromosomes & Cell Reproduction – Ch. 6, 9

California Content Standards 2f, 5a and b

- Structure and function of DNA and chromosomes
- Cell cycle
- DNA replication and cytokinesis
- Mitosis

Unit VII – Meiosis and Sexual Reproduction – Ch. 7

California Content Standards 2a-g

- Gamete, zygote and haploid cell formation
- Crossing over, independent assortment, genetic diversity, and variation
- Asexual reproduction

Semester 2

Unit VIII - Genetics and Heredity – Ch. 8

California Content Standards 3a-d

- Origin of genetics and Mendel
- Punnett squares
- Probability of alleles
- Law of Segregation, Law of Independent Assortment, and the Law of Hybrids
- Dihybrid crosses
- Study of heredity, patterns of heredity and pedigrees
- Genetic diseases

Unit IX – Proteins Synthesis and Gene Technology – Ch. 9, 10, 11

California Content Standards 1d, 4a-f, 5a-e

- Protein synthesis in the cell
- DNA regulation of proteins
- Structure and function of the 4 forms of RNA
- How amino acids relate to protein formation and chemical properties
- Methods and ethics of genetic engineering
- Mitochondrial DNA

Unit X - Evolution, Classification, and Diversity of Life – Ch. 12, 13, 14, 15, 20

California Content Standards 7a-f, 8a-g

- Basic history of life on Earth
- Organism classification
- Kingdoms of life
- Mechanisms of evolution
- Punctuated equilibrium

Unit XI – Ecology – Ch. 16, 17, 18, 19

California Content Standards 6a-g

- Population studies
- Energy flow and ecosystems
- Cycles in ecosystem
- How communities interact including competition
- Study of biomes
- Human impact, global change and environmental issues
- Sample collection and studies

Unit XII – Physiology and Anatomy – Ch. 38, 39, 40, 41, 42, 43

California Content Standards 9a-i, 10a-f

- Anatomy and physiology of the following:
- Circulatory and Respiratory system
- Digestive and excretory system
- Immune system and response
- Nervous system
- Endocrine system
- Muscular and skeletal systems

SUBJECT AREA CONTENT STANDARDS TO BE ADDRESSED:

First Semester

Cell Biology (15% of California State Test [CST])

1. **The fundamental life process of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept;**
   a. Students know cells are enclosed within semi permeable membranes that regulate their interaction with their surroundings.
   b. Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on temperature, ionic conditions, and the pH of the surroundings.
   c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.
   d. Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.
   e. Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.
   f. Students know energy is captured from sunlight by chloroplasts and stored through the synthesis of sugars from carbon dioxide.
   g. Students know the role of mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.
   h. Students know most macromolecules (polysaccharides, nucleic acids proteins, lipids) in cells and organisms are synthesized from a small collection of precursors.
   i. *Students know how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.
   j. *Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.

This standard correlates specifically to Holt Biology, Unit I, chapters 1-6.

Genetics (30% of CST)

2. **Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept;**
   a. Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.
   b. Students know only certain cells in a multicellular organism undergo meiosis.
   c. Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.
   d. Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).
   e. Students know why approximately half of an individual's DNA sequence comes from each parent.
   f. Students know the role of chromosomes in determining an individual's sex.
   g. Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.

This standard correlates specifically to Holt Biology, unit 2, chapter 7.

3. **A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept;**
   a. Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode inheritance (autosomal or X-linked, dominant, or recessive).
   b. Students know the genetic basis for Mendel's laws of segregation and independent assortment.
   c. *Students know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.
   d. *Students know how to use data on frequency of recombination at meiosis to estimate
   e. Genetic distances between loci and to interpret genetic maps of chromosomes.

This standard correlates specifically to Holt Biology, chapter 8

4. **Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept;**
   a. Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.
   b. Students know how to apply genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.
   c. Students know how mutations in the DNA sequence of a gene may not affect the expression of the gene or the sequence of the amino acids in an encoded protein.
   d. Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather then to differences of the genes themselves.
   e. Students know proteins can differ from one another in the number and sequence of amino acids.
   f. *Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.

This standard correlates specifically to Holt, Biology, chapters 8, 10.

5. **The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis of understanding this concept;**
   a. Students know the general structures and functions of RNA, DNA, and protein.

b. Students know how to apply base-paring rules to explain precise coping of DNA during semi conservative replication and transcription of information from DNA to mRNA.
c. Students know how genetic engineering (biotechnology) is used to produce biomedical and agricultural products.
d. *Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.
e. *Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.

This standard correlates specifically to Holt Biology, chapters 9, 11.

<u>Second Semester</u>

Ecology (11.7% of CST)

6. Stability in an ecosystem is a balance between competing effects. As a basis of understanding this concept;

a. Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations in habitat.
b. Students know how to analyze changes in an ecosystem resulting in changes in climate, human activity, introduction of nonnative species, or changes in population size.
c. Students know how fluctuations in population size in an ecosystem are determined by the relative rats of birth, immigration, emigration, and death.
d. Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem, and how oxygen cycles through photosynthesis.
e. Students know a vital part of an ecosystem is the stability of its products and decomposers.
f. Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be in an energy pyramid.
g. *Students know how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.

This chapter correlates specifically to Holt Biology, Unit 4, chapters 16, 17, 18, and 19.

Evolution (15% of CST)

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. As a basis for understanding this concept;

a. Students know why natural selection acts on the phenotype rather then the genotype of an organism.
b. Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.
c. Students know new mutations are constantly being generated in a gene pool.
d. Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.
e. *Students know the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature.
f. *Students know how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in a population, given the frequency of phenotypes.

This standard correlates specifically to Holt Biology, unit 3, chapter 13.

8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept;

a. Students know how natural selection determines the differential survival of groups of organisms.
b. Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment.
c. Students know the effects of genetic drift on the diversity of organisms in a population.
d. Students know reproductive or geographic isolation effects speciation.
e. Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.
f. *Students know how to use comparative embryology, DNA or protein sequence comparisons, and other independent sources of data to create a branching diagram (cladogram) that shows probable evolutionary relationships.
g. *Students know how several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another.

This standard correlates specifically to Holt Biology, unit 3, chapters 12 – 15 and 20.

Physiology (18.3% of CST)

9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept;

a. Students know the complementary activity of major body systems provides cells with oxygen and nutrients, and removes toxic waste products such as carbon dioxide.
b. Students know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.
c. Students know how feedback loops in the nervous and endocrine systems and regulates conditions in the body.
d. Students now the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.
e. Students know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.
f. *Students know the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts
g. *Students know the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance.
h. *Students know the cellular and molecular basis of muscle contraction, including the roles of actin, myocin, Ca^{2+}, and ATP.
i. *Students know how hormones (including digestive, reproductive, and osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.

This standard correlates specifically with Holt Biology, unit 9, chapters 38 – 40, 42 – 44.

10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response;

a. Students know the role of the skin in providing nonspecific defenses against infection.
b. Students know the role of antibodies in the body's response to infection.
c. Students know how vaccination protects an individual from infectious diseases.
d. Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatment of these infections.

e. Students know why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.
f. *Students know the roles of phagocytes, B-lymphocytes, T-lymphocytes in the immune system.

This standard correlates specifically with Holt Biology, unit 9, chapters 21, 41.

Investigation and Experimentation (10% of CST)

1. **Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will**:
   a. Select and use appropriate tools and technology (such as computer inked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
   b. Identify and communicate sources of unavoidable experimental error.
   c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
   d. Formulate explanations by using logic and evidence.
   e. Distinguish between hypothesis and theory as scientific terms.
   f. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
   g. Recognize the issues of statistical variability and the need for controlled tests.
   h. Recognize the cumulative nature of scientific evidence.
   i. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
   j. Know that when an observation does not agree with accepted scientific theory, the observation is sometimes mistaken or fraudulent and that theory is sometimes wrong.
   k. Be able to conduct student-based research projects or science fair projects individually or collaboratively.

This standard correlates to all chapters in Holt Biology Principles and Explorations and laboratory experiments done throughout the course.

THIS COURSE WILL PREPARE STUDENTS FOR THE CAHSEE AND/OR CSTs:

Writing, Reading, Math, Science

LAB FEE IF REQUIRED:

None

DISTRICT ESLR'S TO BE ADDRESSED:

- **Self-Directed Learners:** Students will be expected to take responsibility for their learning by participating in class activities, labs, and discussions. Students will be expected to keep up with homework and lab prep assignments. Students will be expected to do a research project and presentation.

- **Effective Communicators:** Students will actively participate in class discussions on a regular basis. Students will be expected to present information to the class in the form of projects. Students will be expected to interpret and communicate laboratory data.

- **Quality Producers/ Performers:** Assessment of class work requires students to be quality producers in order to be successful in class. Students will be expected to produce quality reports demonstrating their organization, analysis and understanding of concepts in class and laboratory.

- **Constructive Thinkers:** Students will participate in many hands-on activities and labs that require them to analyze their results, think critically and apply what they have learned to new situations.

- **Collaborative Workers:** Students will participate in cooperative groups for laboratory assignments and in class activities. They will be expected to collaborate with each other in developing class concepts.

- **Responsible Citizen:** In order to become responsible citizens, students will use their knowledge of biology and scientific inquiry to make informed decisions about issues related to biology and the environment, and in their daily lives.