Course No: S 759

Orange Unified School District

BIOLOGY HONORS

Year Course

GRADE LEVEL: 9-10

PREREQUISITES: B or better grade in middle school Science.
B or better grade in previous high school Science course.
Recommended that IPS (Introduction of Physical Science) be taken before Honors Biology, if available.
Recommended reading level at 9th grade or above.
Completion of Algebra I with a grade of B or better.
Concurrent enrollment in Geometry.
Meet criteria for Gifted and Talented Education (GATE)/Honors Program.

INTRODUCTION TO THE SUBJECT:

Honors Biology is a college preparatory course that meets part of the University of California laboratory science entrance requirement. Honors Biology is designed for highly motivated students who may have the desire to pursue a career in a science related field. The course requires that all students participate personally in the scientific process through an experimental project or research paper per semester. Emphasis is on the investigative nature of the biological sciences. Through laboratory experiences and field studies, students are led to observe, experiment, form hypotheses, collect and verify data, and apply basic research methods. Skill in the use of laboratory materials is developed. Independent study skills are a must. A considerable amount of reading and written homework is required. The students will study basic chemistry as applied to biology, concepts of cellular biology, energy and life processes (photosynthesis and respiration), comparative study of life processes of selected plants and animals, nucleic acids (DNA/RNA), protein synthesis, genetics, vertebrate reproduction and development, evolutionary theory, ecosystems, biological effect of man on the environment and human biology. Level of study will be at more depth than biology.

COURSE OBJECTIVES: (Science Content Standards denoted)

BY THE END OF THE COURSE THE STUDENT WILL BE ABLE TO:

Solve a problem using scientific method. (Investigation and Experimentation 1b-d, 1f-g, 1j-n)

Achieve a working knowledge of scientific vocabulary, techniques, and equipment. (Investigation and Experimentation 1a, 1e)

Develop an understanding of cells as a unit of structure, function, and organization in living things. (Cell Biology 1a-j)

Describe evolutionary principles as a basis for biological science. (Evolution 7a-f, 8a-g)

Describe the major chemical reactions that occur in living things. (Cell Biology 1b, 1f-h; Genetics 4e-f)

Describe how systems in living things function to maintain homeostasis. (Physiology 9a-i, 10a-f)

Describe the factors that are influential in maintaining and changing ecosystems. (Ecology 6a-g)

Develop an understanding of the laws of heredity and their application to genetics and evolution. (Genetics 2-5; Evolution 7a-c)

COURSE OVERVIEW AND APPROXIMATE UNIT TIME ALLOTMENTS:

FIRST SEMESTER		**WEEKS**
I.	Introduction to Biology	2
	A. Scientific method	
	B. Problem solving	
	C. Lab safety	
	D. Characteristic of living things	
II.	Chemistry	3
	A. Basic atomic structure	
	B. Chemical bonding	
	C. Chemical equations	
	D. Biochemistry	
III.	Cell Biology	3
	A. Cell and organelle structure and function	
	B. Cell theory	
	C. Membrane structure and function	
	D. Cell specialization and levels of organization	
	E. Comparison of prokaryote/eukaryote	

		WEEKS
IV.	Energy Relationships	3
	A. Energy flow	
	B. Photosynthesis/Cellular Respiration/Fermentation	
V.	Nucleic Acid	2
	A. DNA/RNA structure and function	
	B. Protein synthesis	
	C. Gene regulation	
VI.	Cell Cycle and Differentiation	2
	A. Mitosis	
	B. G_1, S, G_2 Phases	
	C. Cytokinesis	
	D. Compare and contrast plant and animal cell cycles	
	E. Asexual mechanism of reproduction	
VII.	Sexual Reproduction and Genetics	3
	A. Meiosis/Oogenesis/Spermatogenesis	
	B. Mendelian/Non-Mendelian monohybrid and dihybrid crosses	
	C. Recombinant DNA technologies	

SECOND SEMESTER

I.	Evolution	2
	A. Development of evolutionary theory	
	B. Evidence and fossil record	
	C. Speciation	
	D. Population genetics	
II.	Ecology	3
	A. Biospheres/Ecosystems	
	B. Populations	
	C. Cycles	
III.	Kingdom Survey with Life Cycles and Classification	4
	A. Modern taxonomy	
	B. Dichotomous key	
	C. Virus	
	D. Monera kingdom	
	E.	

			WEEKS
	E.	Protist kingdom	
	F.	Fungi kingdom	
	G.	Plant kingdom	
	H.	Animal kingdom	
IV.	Seed Plant System		2
	A.	Gymnosperm	
	B.	Angiosperm	
V.	Animal Systems		3
	A.	Invertebrates	
	B.	Vertebrates	
VI.	Human Physiology		4-5
	A.	Nervous/Endocrine	
	B.	Skeletal/Muscular	
	C.	Circulatory/Respiratory/Immunology	
	D.	Digestive/Excretory	
	E.	Reproduction/Development	
		Total Weeks:	37

Reference to *Modern Biology* (2003)

I.	Introduction to Biology	Chapter 1
II.	Chemistry	Chapters 2-3
III.	Cell Biology	Chapters 4-5
IV.	Energy Relationships	Chapters 6-7
V.	Nucleic Acid	Chapters 10, 11, 13
VI.	Cell Cycle and Differentiation	Chapter 8
VII.	Sexual Reproduction and Genetics	Chapters 9, 12
VIII.	Evolution	Chapters 14-16
IX.	Ecology	Chapter 19-22
X.	Kingdom Survey with Life Cycles & Classification	Chapters 18, 24-28, 30, 34
XI.	Seed Plant System	Chapters 29, 31-33
XII.	Animal Systems	Chapters 35-45
XIII.	Human Physiology	Chapters 46-52

DATE OF CONTENT REVISION: March 2003

DATE OF BOARD APPROVAL: April 24, 2003

Addendum

THE CALIFORNIA CONTENT STANDARDS
BIOLOGY/LIFE SCIENCES
INVESTIGATION AND EXPERIMENTATION
GRADES 9-12

BIOLOGY/LIFE SCIENCES

Cell Biology

1. The fundamental life processes 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 semipermeable 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 the 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* usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.

    g. *Students know* the role of the 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 simple 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.

Genetics

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.

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 of 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 genetic distances between loci and to interpret genetic maps of chromosomes.

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 the 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 or may not affect the expression of the gene or the sequence of 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 than 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.

5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:

a. *Students know* the general structures and functions of DNA, RNA, and protein.

b. *Students know* how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.

c. *Students know* how genetic engineering (biotechnology) is used to produce novel 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.

Ecology

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

   a. *Students know* biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.

   b. *Students know* how to analyze changes in an ecosystem resulting from 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 rates 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 and respiration.

   e. *Students know* a vital part of an ecosystem is the stability of its producers 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 represented 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.

Evolution

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 than 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.

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 affects 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.

Physiology

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* how 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 regulate conditions in the body.

d. *Students know* 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, myosin, Ca^{+2}, and ATP.

i.* *Students know* how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms.

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 treatments 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, and T-lymphocytes in the immune system.

INVESTIGATION AND EXPERIMENTATION

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-linked 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. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.

   f. Distinguish between hypothesis and theory as scientific terms.

   g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.

   h. Read and interpret topographic and geologic maps.

   i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

   j. Recognize the issues of statistical variability and the need for controlled tests.

   k. Recognize the cumulative nature of scientific evidence.

l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e. g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).