Course No: G 705

Orange Unified School District

AGRICULTURAL BIOLOGY

Year Course

GRADE LEVEL: 9-12

PREREQUISITES: Completion of Algebra I.

INTRODUCTION TO THE SUBJECT:
Agricultural Biology is a laboratory science course designed for the college-bound student. The course emphasizes detailed knowledge of the biological principles of molecular and cellular aspects of living things, structure and function of agricultural plants and animals, genetics, physiology, plant and animal diversity and principles of classification, ecological relationships, and animal behavior.

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

- Intelligently discuss theories on the origins of life.
- Describe the characteristics of living organisms.
- Describe the characteristics of plant and animal cells with respect to their structure and chemistry.
- Compare and contrast the roles of meiosis and mitosis in cellular and organism reproduction.
- Define the chromosome theory of heredity, Mendelian genetics, gene-enzyme relationships, and apply this knowledge to animal inheritance.
- Distinguish between historical and modern taxonomy systems and scientific nomenclature that demonstrate evolutionary relationships among plants and animals.
- Identify the structural and functional similarities and differences among the major animal, plant, and protist phyla.
- Analyze the major organ systems of animals and understand their function.
- Recognize the structure and function of ecosystems, populations, and communities, and the impact of human society on the natural and agricultural environment.
- Describe the three cycles that involve biotic and abiotic factors: nitrogen, carbon-oxygen and water; and explain the importance of their interrelationships to the biosphere.
- Identify the environmental and genetic factors that influence variation among organisms.
- Demonstrate basic laboratory techniques including the use of microscopes, microscope slide preparation, maintenance and examination of micro-organism cultures, tests demonstrating fundamental biochemical reactions, dissection of representatives of plant and animal phyla, and the sharpening of interpretative skills.

COURSE OVERVIEW AND APPROXIMATE UNIT TIME ALLOTMENTS:

FIRST SEMESTER		**WEEKS**
I.	Introduction to Agricultural Biology	2
	1. What is Agricultural Biology and its importance	
	2. Research uses of Agricultural Biology	
	3. The scientific method	
	4. The metric system	
II.	Leadership and Team Building Development	2
	1. Oral and speaking presentations	
	2. Critical thinking exercises	
	3. Problem solving exercises	
III.	Organisms and Their Ecological Environment	4
	1. Biodiversity	
	2. Conserving natural resources	
	3. Agricultural practices beneficial and harmful to the environment	
	4. The ecosystem and population fluctuations	
	5. The nitrogen cycle	
	6. The oxygen cycle	
	7. The food web	
IV.	Cell Biology	4
	1. Plant and animal cell identification and functions	
	2. Plant and animal cell structure and functions	
	3. Cellular respiration	
	4. Cellular transport	
	5. Cell differentiation	
	6. Chemiosmotic gradients and ATP production	
	7. Macromoecules in cells	
V.	Inorganic Foundations that Support Life	2
	1. Soil and water: The chemical foundation	
	2. Atomic and molecular structure and chemical bonding	
	3. Basic soil components	
	4. Soil formation factors and horizons	
	5. Soil texture and structure	
	6. Soil organisms and organic matter	
	7. Interrelationships of plants and soil	
	8. Water movement properties	
	9. Soil and water management	
VI.	Plant and Animal Classifications	2
	1. Development of the Binomial System of Nomenclature	
	2. Classifications of major groups of plants and animals	
	3. Evolutionary relationships	

4. Development of the kingdom concept
5. Comparisons of modern agricultural plants and animals

VII. Plant Physiology, Reproduction, Photosynthesis and Growth 2
1. Plant structures and the process of photosynthesis
2. Plant growth requirements
3. Monocotyledons and dicotyledons
4. Sexual and asexual reproduction
5. Research applications to plant biotechnology
6. Chemical and environmental factors affecting plant growth

Total Weeks 1st Semester: 18

SECOND SEMESTER

I. Agricultural Biology Research Project 4
1. Development and formulation of Agriscience/Science Fair project
2. Research principles and design
3. Statistical management and analysis of Agriscience/Science Fair project
4. Instructional supervision and coordination

II. Animal Physiology and Reproduction 4
1. Internal systems of animals
2. The digestive process
3. The respiratory system
4. The reproductive system
5. The circulatory system
6. The endocrine system
7. The nervous system
8. The immune system

III. Animal Nutrition 4
1. Feed identification and nutrient evaluation
2. Feed additives
3. Ration formulation
4. Animal nutrient requirements
5. Vitamin and amino acid requirements
6. Nutritional diseases

IV. Animal Health and Diseases 2
1. Disease agents
2. Causes of disease
3. Infectious and noninfectious diseases
4. Animal health practices
5. Common internal and external parasites lifecycles

V. Plant and Animal Genetics 4
1. Heritability and genetic traits
2. Dominant and recessive genes

3. Genotype and phenotype
4. Cellular reproduction: Mitosis and meiosis
5. Physical and chemical structures involved in genetics
6. DNA and types of DNA
7. DNA replication
8. Mendel – independent assortment and segregation
9. Biotechnology and cloning
10. Proteins and RNA
11. Role and function of amino acids in genetics
12. Mutation and sexual reproduction

Total Weeks 2nd Semester: 18

TEXTS & SUPPLEMENTAL INSTRUCTIONAL MATERIALS:

- Modern Biology 2nd Edition (Holt, Rinehart & Winston, 2000)
- Laboratory Investigations in Biology (Holt, Rinehart & Winston, 2000)
- Biological Science Applications in Agriculture (Osborne, 1999)
- Agriculture Biology Lab Manual Revised (Fullerton, 1999)

KEY ASSIGNMENTS:

- Weekly Reading & Writing Assignments
- Weekly laboratory activities & write-ups
- Agriculture Biology Term Paper
- Supervised Agricultural Experience Project & Record Book
- Student Seminar Presentation related to Agriculture Biology Topic
- Portfolio of Laboratory Exercises
- Leadership Development Activities

INSTRUCTIONAL METHODS:

- Students will be engaged in a variety of activities that balance direct instruction with project work.
- Students will be expected to apply the academic and applied concepts and processes learned during direct instruction to their projects.
- Students will attend lectures, complete labs, become involved with professional mentors, complete real world projects, and make presentations that demonstrate understanding of physical concepts and the application process.
- Methods of instruction will include, but is not limited to:
    - Direct instruction (lectures, discussions, readings, and lab activities specific for mastery of content).
    - Use of community-based research projects and with professional mentors, development of language arts skills while students complete reports, journals, analyses, and essays.
- Use of a variety of instructional materials and resources including electronic media, handbooks, professional journals, reference materials, and textbooks.
- Self-directed, cooperative, and collaborative learning opportunities to increase responsibility of students for their own learning.

- Use of student presentations, exhibits, and competitions.

ASSESSMENT METHODS:

Assessment opportunities that allow continuous evaluation of students' progress should be embedded throughout the course and should be a learning experience. All students will be expected to achieve a high understanding of all topics; often demonstration of knowledge will occur in a public forum. The following strategies, which include both formal and informal assessment techniques, may include, but are not limited to:

1. Performance-based assessments such as demonstrations, discussions, simulations, and projects
2. Presentations, (both team and individual) written assignments, (both team and individual),
3. On-going and cumulative portfolio of investigative accomplishments.
4. Written tests & quizzes with a variety of short answer and essay questions.
5. Written assignments, (such as justifications, investigations, and research, evaluative, or technical), and individual and group assessments including the assessment working relationships.

Grading will be based on the following assessment areas:

1. Tests & Quizzes	40%
2. Laboratory Investigation Activities & Write-ups	20%
3. Portfolio & Writing Assignments	15%
4. Leadership & Critical Thinking Activities	10%
5. Research Report and Oral Presentation	10%
6. Supervised Agricultural Experience & Record Book	05%

IX. LABORATORY ACTIVITIES:

The Scientific Method
Analyzing Ecosystems
Checking water for Coliform Bacteria
Genotypic and phenotypic ratios
Cell identification
Flower dissection and pollen growth germination
Secondary and microelements with N-P-K tissue tests on plants
Animal tract dissection
Reproductive tract dissection
Feed nutrient analysis
Factors affecting photosynthesis
Effects of leaf surface area, air movement, and light on transpiration rates
Effects of light quality on plant growth
Artificial insemination & embryo transfer
Phototropism
The Hydrologic Cycle
Comparison of soil vs. non-soil plant culture
Effects of nutrient concentrations on hydroponic plant growth
Effects of chemicals (herbicides) on plants
Herbicide biopsy
Effects of rooting hormone on root development
Balancing feed rations
Anther culture
DNA extraction
Probability of trait inheritance
Tissue culture
Seed disperal
Genetic probability
Insect identification

Environmental forcing structures | Water quality
Comparison of asexual propagation methods | Plant pigment chromatography

DATE OF CONTENT REVISION: NEW – March 2006

DATE OF CURRENT CONTENT REVISION: April 2009

DATE OF BOARD APPROVAL: April 20, 2006

ADDENDUM

THE CALIFORNIA CONTENT STANDARDS
BIOLOGY/LIFE SCIENCE
GRADES 9-12

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 under-standing 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.