Sustainable Agriculture

Meets the UC "g" Admission Requirement

I. COURSE INFORMATION:

A. Course Title: Sustainable Agriculture

B. Grade Level: 9-10 Grades

C. Length of Course: 1 year

D. Prerequisites: Algebra I or concurrent enrollment

E. Credit: 10 Units

II. MAJOR GOAL AND STUDENT OUTCOMES:

A. Agriculture Science I course is offered to first year agriculture students who are planning to major in agriculture in a college or university. Using agriculture as the learning vehicle, the course emphasizes the principles, central concepts and interrelationships among the following topics: the molecular and cellular aspects of life, the chemical and structural basis of life, growth and reproduction in plants and animals, evolution of modern plants and domestic livestock species, plant and animal genetics, taxonomy of modern agricultural plants and animals, animal behavior, ecological relationships among plants, animals, humans and the environment, nutrition in animals, health and diseases in animals, and the similarities between animals and humans. The course is centered around an extensive laboratory component in order to connect the big ideas of life science with agricultural applications, earth and physical science principles, and other curricular areas, including written and oral reporting skills.

III. COURSE OBJECTIVES:

A. The course objectives are as follows:

1. Utilize agricultural applications as a relevant vehicle to teach biological science principles and improve the scientific literacy of students.

2. Strengthen instruction in science for students pursuing professional level careers in agriculture.
3. Integrate mathematics standards, language arts standards, and career employability standards including creative thinking and problem solving skills, and technological literacy related to the agricultural industry.
4. Meet a portion of the laboratory science requirement for admission to the University of California and California State University systems.
5. Develop a sense of the interrelationships between life, earth, and physical science and their relationship to agricultural applications.
6. To motivate underrepresented populations to study and pursue professional development opportunities in science and agriculture.

IV. COURSE OUTLINE:

A. Introduction to Agricultural Biology

1. What is agricultural biology and why is it important?
2. How does biology in agriculture impact the student?
3. What are the career opportunities for the student in agricultural biology?

B. Agricultural Research

1. Why is research important?
2. What does an agricultural researcher do?
3. How do researchers go about conducting research?
4. What are the principles of research?
    a. Project formulation and development
    b. Project management & data collection
    c. Analysis of project results

C. Agriculture and the Environment

1. What are the characteristics of living things?
    a. Cells The Building Blocks of All Life Forms
        1. Plant and animal cell identification and function
        2. Cell structure
        3. Cellular respiration
        4. Cellular transport
        5. Cell differentiation

2. What are the inorganic characteristics that support life?

a. Soil and Water: The Chemical Foundation
    1. Atom and molecule structure and chemical bonding
    2. Soil: What are the components of soil and why are different soil samples found where they are?
        a. Basic soil components
        b. Soil formation factors and horizons
        c. Soil texture, and structure
        d. Soil organisms and organic matter
        e. Interrelationships of plants and soil
    3. Water and water movement properties
    4. Soil and water management

3. How do living organisms interact with the environment? Why do the weather and other abiotic factors affect living organisms?
    a. Structure and function of ecosystems
    b. The Food Web
    c. The "agricultural revolution" and the environment
    d. Demographics and the environment
    e. Modern agricultural practices and the environment

4. How are plants and animals classified?
    a. Taxonomy of living organisms
    b. Evolutionary relationships with other major groups
    c. Comparison of modern agricultural crops and livestock to ancestors

D. Plant Physiology, Reproduction, Photosynthesis and Growth

1. What are the structures and functions of plants?
2. How do plants grow?
    a. Seed germination
    b. Photosynthesis and respiration
3. How do plants reproduce?
    a. Sexual reproduction
    b. Asexual reproduction.
4. How have modern agricultural practices and biotechnology changed plants?
5. What is the role of plants in nutrition and medicine?

E. Animal Physiology, Reproduction, Nutrition, Health and Behavior

1. What are the internal systems of animals? How do these systems differ among species? How are they similar?

2. How do these systems interact to sustain life and promote growth?
    a. The digestive process
    b. The respiratory system
    c. The reproductive system
    d. The circulatory system
    e. The endocrine system
    f. The nervous system
3. Why do animals interact with each other? How does behavior affect management and feeding strategies?
4. What do we feed domestic animals? How is food processed within the body? What are the important characteristics of feeds? What are the animal's nutrient requirements?
    a. Feed identification and nutrient evaluation
    b. Livestock nutrient requirements
    c. Ration formulation
5. What are the major diseases that affect animals? How do these diseases spread? How does the body prevent and fight diseases and infections? What management practices can reduce the incidence of health problems?

F. Plant and Animal Genetics

1. How are traits passed on?
2. How do cells reproduce?
    a. Mitosis
    b. Meiosis
3. What are the physical and chemical structures involved in genetics?
4. Who were some famous geneticists? What were their contributions?
5. Why are genetics important in production agriculture?
6. What are some future careers in genetic research?

G. Plant Pathology and Entomology

1. What are common plant diseases?
2. What effect do harmful insects have on development and growth?
3. What is method of control?
4. Identify the Orders of Insects
5. Identify insect structures and development
6. What are effective IPM practices?

H. Biotechnology Applications

1. What is Biotechnology?

2. What is the importance of Molecular biotechnology?
3. What is genetic engineering
4. What is tissue culturing?

I. Soil Structure and Function

1. What are the components, function, economic uses, and relationship to the earth?
2. What is the Geologic Cycle?
3. What is the importance of chemical and physical weathering to the Earth?
4. Describe the different types of soil formations.

J. Professional Opportunities in Agriculture Science & Biology

1. Biotechnology & research fields
2. Other related science fields

K. Agricultural Inter-Personal & Leadership Development

1. Completion of a Supervised Agricultural Experience Program and data collection
2. Development of listening, speaking, writing & reading skill activities
3. Critical thinking & group team building activities
4. Agriculture presentations

V. TEXTS & SUPPLEMENTAL INSTRUCTIONAL RESOURCES:

MODERN BIOLOGY (2002). Holt, Rinehart, Winston Publishers.

Burton, L. DeVere AGRISCIENCE AND TECHNOLOGY (1999). Albany, New York: Delmar Publishers.

Cooper, Elmer L. AGRISCIENCE: FUNDAMENTALS AND APPLICATIONS (1998). Albany. New York: Delmar Publishers.

Cooper, Elmer L. AGRISCIENCE: FUNDAMENTALS AND APPLICATIONS LABORATORY MANUAL (1998). Albany. New York: Delmar Publishers.

VI. KEY ASSIGNMENTS:

A. Research Paper on Biological Principles of Agriculture
B. Seminar Presentation on Biological Principles of Agriculture

C. Development of Science Fair Project relating to Agricultural Science II
D. Laboratory activities
E. Supervised Agricultural Experience Project & Data Collection
F. FFA Leadership Participation
G. Development of Student Portfolio

VII. INSTRUCTIONAL METHODS:

A. Instructional methods include:

1. Classroom instruction, including:
   - Discussion
   - Demonstration
   - Lecture
   - Examinations
   - Reading assignments
   - Guest speakers

2. Laboratory and/or field instruction, including:
   - Science laboratory experience
   - Field research projects & report

3. FFA leadership experiences, including:
   - Verbal and written communication exercises
   - Leadership development activities

4. Supervised Agricultural Experience Research Project
   - Individually developed Supervised Agricultural Experience Research Project
   - Record Book
   - Data collection

VIII. ASSESSMENT

1. 40% of the grade will be based on classroom instruction, including:
   - Exams & Tests
   - Quizzes
   - Research Paper
   - Homework and reading assignments

2. 40% of the grade will be based on laboratory and field research exercises

3. 20% of the grade will be based on the student portfolio, including:

- Key classroom projects
- Major field and laboratory activities
- Written summaries of individual research projects
- Supervised Agricultural Experience Project & Record Book
- Summaries of leadership/personal development achievements and activities

IX. LABORATORY ACTIVITIES

The laboratory activities are examples of general types of laboratory and field experiments that integrate many areas of life, physical, and earth sciences and agriculture. The purpose of general, rather than specific, experiments is to give students an understanding of the interrelationships among scientific disciplines.

A. Scientific Research

Students will complete a research project to gain an understanding of the importance of agricultural research.

1. Discovering the Problem, Formulation of the Hypothesis and Creation of Experimental Design
2. Students will State a problem, establish the hypothesis, create experimental design, and write the introduction.
3. Data Collection
4. Students will collect data and enter into a journal. This information will be entered into Microsoft Excel program to create and display graphs of the data.

5. Interpreting the Data and Drawing conclusions. Students will analyze and draw conclusions from the data.

B. Semester Research Project

1. Outside of class time, each student will design and carry out an individual semester long research project. The first quarter of the year, each student will select a topic, perform library research, and form a Hypothesis or research for questions. The first quarter will also include the development of the methodology and design of the project. At that point they may begin to carry out the experiment. By the second quarter they should be well into data collection. The remainder of the second quarter should consist of data analysis and summarization of results. By the end of the semester students will have completed a research paper, prepared an exhibit and presented an oral presentation of their research.

C. Agriculture and the Environment

1. Students will appraise at least three current issues regarding Biology's affect on the environment. Report on both the good and bad affects of the Agricultural revolution on the environment. Develop and defend a plan to preserve limited resources related to Agriculture.

D. Demographics, Living Systems, and the Ecosystem Activity

1. Students will draw a natural food web, including: plants, insects, larger animal species, and humans. Compare the natural food chain to an artificial chain developed in production agriculture. Diagram the interrelationships of different systems in the food web, which consist of Nitrogen and Oxygen cycles, the effects of increasing populations, and the importance of plants to all participants in the food web. Use a trashcan to make either compost or silage in order to demonstrate how the breakdown of organic materials leads to the production of beneficial elements.

E. Cell Identification

1. Students will prepare both plant and animal slides for analysis. Prepared slides of blood, nerve, muscle bone and fat cells will be observed to show cell differentiation. Single celled organisms on prepared slides will be compared to those of plant and animal cells.

F. Observing Osmosis

1. Students will fill dialysis tubing with both glucose and starch solution and place in a beaker of water. Test the water in the beaker to determine if either of the two solutions diffused from the dialysis bag. Conclude why the substances diffused or did not diffuse from the tubing.

G. Testing for Soil Organic Matter

1. Students will test various soil samples for organic matter content. Soil samples are put in two liter bottles, Hydrogen Peroxide is added, a balloon is attached to the top of the bottle. The hydrogen peroxide reacts with the organic matter, the larger the balloon size

indicates a higher presence of organic matter. Finally students must draw conclusions as to why some soils contained more than others.

H. Soil Characteristics and Plant Growth

1. Students will design and conduct an experiment that shows the relationship between soil characteristics and plant growth. Set-up a separate experiment with plants grown hydroponically. Compare the results of both experiments.

I. Soil and Water

1. Students will conduct an experiment that involves water movement through soil. Describe how agriculture practices can modify soil to improve soil moisture relationships.

J. Pollution and Ecology

1. Students will set-up a fish tank in the classroom and introduce small amounts of common chemical pollutants in order to increase the nutrient content of water over a period of time. Regularly take and record measurements, including, water temperature, pH, water clarity, and visual observations of changes. Apply a heat source to the water to increase algae growth.

K. Soil and Water Conservation

1. Student teams will prepare a class presentation demonstration on soil and water conservation. Include a model to demonstration on the effects of slope or soil type on soil loss due to soil erosion by water. Give short presentations on conservation topics.

L. Taxonomy of living things "Plants"

1. Collect ten different plants and develop a key to determine the species of each. Provide two similar plants of different species, have students list the differences between the two. Discuss three reasons for the current use of modern systems of plant classification.

M. Taxonomy of living things "Insects"

1. Collect ten different insect species and develop a key to determine the species of each. Given two similar insects of different species, students list the differences between the two. Apply taxonomy in three ways to the field of agriculture.

N. Compare and contrast modern animals to their ancestors

1. Students will select an animal species. Diagram the phytogenic tree of the animal and list the differences that have occurred over time due to evolution. Compare modern agriculture plants, such as oats, to their relatives that grow in the wild, in order to show the differences due to selection, hereditary, and biotechnology.

O. Transpiration Calculation

1. A section of a plant is placed in a graduated cylinder of water. Students will record the rate of transpiration. From that data, calculate the total daily plant transpiration rate.

P. Flower Dissection

1. This lab will give the students the opportunity to understand sexual reproduction in plants. Students dissect the flower under a dissecting microscope, label parts and indicate their function in reproduction.

Q. Monocotyledons and Dicoltyledons

1. Examine a cross section of a stem, leaf, and root of both Monocotyledons and Dicotyledons. Students compare, contrast, draw the various structures, and indicate their functions. View magnified cross sections of those parts.

R. Photosynthesis Investigation

1. If only part of the leaf receives light, does the whole leaf perform photosynthesis? What if a leaf receives light of only one color? Students design an experiment to test the effects of colored light on photosynthesis. Defend the role of green plants in the maintenance of life.

S. Asexual Propagation

1. Students will perform grafts, cuttings, and budding. This will be followed up by a lab write up, which will include diagrams and descriptions of all of the steps for each method of propagation. Discuss how asexual reproduction is used in Agriculture.

T. Comparison of Animal Systems

1. Students will write a comparison and contrast analysis of the organ systems of the different livestock species. Draw three different livestock digestive systems. Explain the process of digestion in each animal by tracing the pathways of food. Compare and contrast the function of the organs in each system with emphasis on the digestive process.

U. Animal Reproduction

1. Compare and contrast the estrus and menstrual cycles of cattle, sheep, and swine to that in humans. Chart the process of fertilization in each species. Develop a flow chart outlining the development of an embryo from conception to parturition.

V. Fetal Pig Dissection

1. Students will dissect and identify the body systems and recognize important parts in each system.

W. Animal Behavior

1. Students will form observations on the behavior of pigs and sheep in several different situations. Draw conclusions regarding how behavior affects management and feeding strategies.

X. Animal Feeding Rations

1. Students will develop a balanced ration for their SAEP, taking into consideration the animal's nutrient requirements, availability of feeds in the area, cost, how to analyze the feed nutrient content, and the animal's behavioral patterns. Keep accurate records regarding the feeding program and write a report that includes the development of the project, day-to-day management, and results on

the animal's growth or reproductive performance, as it relates to the diet.

Y. Plant and Animal Genetics

1. Students will use microscopes and slides to show the structure of chromosomes. Diagram the processes of mitosis and meiosis.

Z. Genetic Crosses of Peas

1. Students will start a small garden with different varieties and colors of peas. Cross-pollinate the plants to demonstrate dominance. Explain the functions of gene, alleles, DNA and RNA. Graft two varieties of plants together. Discuss the contributions of Gregor Mendel to the field of genetics.

AA. Reproduction

1. Teacher will use slides or films to show embryo transfer, artificial insemination, cell splitting, and cloning techniques. Students write, or give an oral report describing the future possibilities of bioengineering including the ethical and moral concerns that may arise as a result. Analyze the effects of biotechnology on modern agriculture.

BB. DNA Extraction from animal thymus

1. Students will extract and spool DNA from a sheep thymus.

CC. How Gel Electrophoresis Helps the Identification of a DNA Sample

1. Students will complete the science of a crime lab. The students are the lab technicians about to solve the mystery of "who done it". This highly interactive lab will allow students to see DNA patterns using restriction enzymes. The students will compare the pattern and be able to solve the crime.

DD. Traits and Natural Selection

1. Students will compare and contrast the phenotypic traits of related breeds and varieties of plants. Report on the importance of natural selection as the driving force of evolution and its importance in production agriculture.