

Career Technical Education

COURSE TITLE/CODES:	Chemistry and Agriscience 1-2	000944-000945
RECOMMENDED PREREQUISITES:	Biology or Sustainable Agriculture	
LENGTH OF COURSE/CREDITS:	Two Terms (semester, trimester, quarter) / 5 credits per term	
GRADE LEVELS:	10, 11, 12	
UC REQUIREMENT:	"D" – Science	

I. COURSE DESCRIPTION

This course explores the physical and chemical nature of soil as well as the relationships between soil, plants, animals and agricultural practices. Students will examine properties of soil and land and their connections to plant and animal production. Using knowledge of scientific protocols as well as course content, students will develop an Agriscience research program to be conducted throughout the first semester of the course. Additionally, students will develop and present a capstone soil management plan for agricultural producers, using the content learned throughout the course. This course meets UC "d" requirements as well as PUSD Physical Science credit.

II. COURSE GOALS

The students will:

- A. Identify important agricultural environmental impacts on soil, water, and air.
- B. Explain the reasons for, and importance of, soil conservation.
- C. Recognize the major soil components and types.
- D. Summarize how soil texture, structure, pH, and salinity affect plant growth.
- E. Analyze an agricultural problem and devise a solution based on the scientific method.
- F. Integrate the use of technology when collecting and analyzing data.

III. OBJECTIVES

The students will be able to:

- A. Will learn to ask questions and define problems, conduct research to form a hypothesis, determine the experimental design and conduct experimentation, analyze and interpret data, develop conclusions and then communicate their findings in lab reports
- B. Use the methods of scientific inquiry, developed in the previous unit, to investigate the composition of the physical world, and discover how matter and energy change forms through biogeochemical cycles
- C. Will analyze how the water cycle impacts soil based on its soil type (sand, silt, clay) soil location (geographic and topographic), vegetative state and natural slope of land.
- D. Determine the effects of plant, soil and water interactions with respect to maintaining or restoring environmental health and structure
- E. Correlate the minerals present in soil with the nutrient content of typical livestock concentrate and roughage feeds
- F. Develop an understanding of sustainable agriculture by employing a sustainability evaluation

IV. COURSE OUTLINE

A. Unit 1: Agriscience Practices

This introductory unit will focus on proper methods of agriscience inquiry. Through a series of mini-lab experiences based on the course content, students will learn to ask questions and define problems, conduct research to form a hypothesis, determine the experimental design and conduct experimentation, analyze and interpret data, develop conclusions and then communicate their findings in lab reports. Not only will the students learn to utilize proper scientific method protocol through conducting these mini-labs, they will also learn what topics will be taught throughout the year in order to guide them in University of California Curriculum Integration (UCCI) integrated course: Agriculture and Soil Chemistry, selecting the problem/question for their individual agriscience project. Through these mini-lab experiences and unit content, students will be provided with the skills and knowledge to successfully establish the idea they will pursue in their agriscience project. By the end of this unit, students will complete the agriscience project research proposal for their on-going science experiment that will be conducted throughout the first semester of the course.

B. Unit 2: The Nature of Soil

Students will:

- 1. Use the methods of scientific inquiry, developed in the previous unit, to investigate the composition of the physical world, and discover how matter and energy change forms through biogeochemical cycles.
- 2. Understand where soil originates by investigating the role of the rock cycle in soil formation.
- 3. Learn how the electron configurations of different elements, present in the parent material, give them unique physical and chemical properties, and will further investigate how these properties impact soil characteristics.
- 4. Identify how the climate, weather, and environment impact the soil properties, and examine the role erosion plays in soil science.

5. Collect soil samples from a variety of sources, and use industry methods to determine the chemical composition of the soil and how this composition affects its physical and chemical characteristics.
6. Connect to prior knowledge of life science by looking at how biotic factors impact soil type, composition and texture through investigation and experimentation.
7. Use the results of their soil testing and the locations from which they took their samples to create a soil map of their local area.
8. Compare their map to existing soil maps and analyses, and analyze the similarities and differences with the previous research.

C. Unit 3: Water and Soil Management

Students will:

1. Analyze how the water cycle impacts soil based on its soil type (sand, silt, clay) soil location (geographic and topographic), vegetative state and natural slope of land using knowledge accessed from previous units on the physical and chemical properties of soil.
2. In order to understand how water becomes available for plant growth, explain the movement of water through soil with respect to how intermolecular forces impact percolation, capillary action, pore size, cohesion and adhesion.
3. Address how the concentration of organic matter in soil impacts the movement of water.
4. Explain the impact that soil has on the quality of their water and will use water analysis tests to determine the safe and appropriate levels for potable water.
5. Be able to provide solutions to possible contaminations and/or toxic levels of residues/nutrients in the water samples.
6. Determine how different irrigation, tillage and planting practices will impact the soil and surrounding area by testing water quality, pH and checking for possible contaminants due to leaching.
7. Determine proper and efficient irrigation practices based on the chemistry behind the soil and the way water moves through the soil particles.
8. Use GPS to enable students to more accurately analyze watersheds in their area and rationalize how the drought can impact both water quality and quantity as well as soil composition.

D. Unit 4: Plants and Soil Management

Students will:

1. Building on knowledge acquired from the previous units on the physical and chemical properties of water and soil, begin to determine the effects of plant, soil and water interactions with respect to maintaining or restoring environmental health and structure.
2. Model how nutrients cycle through the environment, analyze how pH affects nutrient availability by changing chemical equilibrium, determine water holding capacity with respect to water availability for plant growth, and identify possible nutrient deficiencies based on plant observations.
3. Apply this learning to developing knowledge of soil nutrients and their role in the environment by testing and analyzing soil samples for optimal soil structure, nutrient value and availability and determining possible soil amendments and practices to improve soil quality.

E. Unit 5: Animals and Soil Management

Students will:

1. Using knowledge from previous units about soil nutrient content, identify the key macrominerals and microminerals necessary for normal livestock growth and reproduction.
2. Correlate the minerals present in soil with the nutrient content of typical livestock concentrate and roughage feeds.
3. Using local resources, identify mineral deficiencies or toxicities in the soil and relate the deficiencies or toxicities to livestock health.
4. Identify crop and range management practices to improve the nutrient content of soil, and explain what reactions take place at the molecular level to improve nutrient content.
5. Identify various methods of using animal waste and the environmental impacts including the use of animal waste as soil amendments and fertilizers.
6. Relate the units of concentration used in agriculture practice to units used in chemistry labs, as they identify problems and contaminants associated with livestock waste disposal and related health and safety regulations.

F. Unit 6: Soil Sustainability

Students will:

1. Based on the accumulation of knowledge, examples and research conclusions from throughout the year, develop an understanding of sustainable agriculture by employing a sustainability evaluation tool, "The 3-Pillars of Sustainability, economic, environmental and social impacts" of agriculture.
2. Critically evaluate and justify perspectives and determine benefits/concerns based on research and credible information.
3. Investigate and evaluate the sustainability of agricultural practices.
4. Design and conduct a phytoremediation lab to analyze the efficacy of salt tolerant accumulators to remove saline from the soil.
5. Formulate potential solutions using the three pillars of sustainability to soil and land management problems based on agricultural scenarios and debate agricultural issues.

G. Capstone Project and Portfolio

1. Soil Management Capstone Project

As the final course capstone project students will:

- a. Be given a scenario and soil sample designed around their local agriculture industry. The given scenario will provide students with specific information about the topography and climate/rainfall data of the location where the soil sample was collected.
- b. Use knowledge and skills learned in previous units to physically and chemically analyze the soil sample. Their soil analysis should include the composition and nutrient, pH, and salinity levels. The data collected from their soil sample analysis and the provided land information should be included in the soil management plan that the students create. The student's Soil Management Plan will recommend soil amendments, proper tillage practices, optimal irrigation methods, crop recommendations, and animal use suggestions. Their recommendations and suggestions should be justified in terms of the 3-pillars of sustainable agriculture.

2. Course Portfolio

The course portfolio will provide evidence of real-world agriculture application of scientific research done throughout this course. The portfolios will highlight student work from throughout the course to show a progression of learning, experimentation, and application of course content. Items that will be included in the portfolio are student lab reports, the Agriscience Research paper, and their Soil Management Plan.

V. BASIC AND SUPPLEMENTARY TEXTS

Primary Materials:

- A. Plant & Soil Science Fundamentals and Applications, Rick Parker. Delmar Cengage Learning.
- B. Principles of Soil Chemistry, 4th edition. Kim Tan. CRC Press.

Supplemental Materials:

- A. Environmental Science Fundamentals and Applications. Delmar Cengage Learning. Chapters 1-3; 5 & 6.
- B. Environmental Science and Technology. Second Edition. Agriscience & Technology. Chapters 10, 13, 14 & 15.
- C. United Concordia Companies, Inc. (UCCI) integrated course: Agriculture and Soil Chemistry | Page 13 of 14
- D. Environmental Science, 10th Edition. G. Tyler Miller, Jr. Chapters 9, 13 & 14.
- E. Environmental Science, 7th Edition. Bernard J. Nebel & Richard T. Wright. Prentice Hall.
- F. The Science of Agriculture A Biological Approach, 2nd Edition. Ray V. Herren. Delmar Thomson Learning.
- G. Agriscience Fundamentals and Applications, 6th Edition. L. DeVere Burton. Cengage Learning. Environmental Science. 1st Edition. 2013. Michael Heithaus, Karen Arms. Houghton, Mifflin, Harcourt.
- H. How to Write a Scientific Paper by Robert A. Day. National FFA Agriscience Fair Handbook
https://www.ffa.org/documents/agsci_handbook.pdf
- I. National Future Farmers of America (FFA) Research Report Template
<https://www.ffa.org/programs/awards/agrisciencefair/Pages/default.aspx>

VI. INSTRUCTIONAL METHODS AND/OR STRATEGIES

Methods of instruction will include, but are not limited to:

- A. Lectures-teacher and student directed
- B. Laboratory experiments
- C. Graphing, representation and analysis
- D. Project-based learning
- E. Research
- F. Empirical method and hypothesis
- G. Portfolio
- H. On demand reflections
- I. Interviews
- J. Guest speakers, field experiences

VII. ASSESSMENT METHODS

Methods of assessment will include, but are not limited to:

- A. Individual projects and portfolios
- B. Team projects
- C. Student presentations
- D. Unit quizzes/tests
- E. Oral presentations
- F. Student peer evaluations
- G. Written proposal and defense
- H. Performance assessments
- I. Client reviews
- J. Final portfolio