Perris Union High School District
Course of Study

A. COURSE INFORMATION

Course Title:
Ag. Chemistry
- ☐ New
- ☐ Revised

If revised previous course name if changed

Transcript Course Code/Number:
204511/204512
(To be assigned by Educational Services)

Subject Area:
- ☐ Social Science
- ☐ English
- ☐ Mathematics
- X Laboratory Science
- ☐ World Languages
- ☐ Visual or Performing Arts
- ☐ College Prep Elective
- ☐ Other

Is this classified as a Career Technical Education course?
- X Yes
- ☐ No

Grade Level
- ☐ MS
- ☐ HS
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- X 10
- X 11
- X 12

Required for Graduation:
- ☐ Yes
- X No

Meets UC/CSU Requirements?
- X Yes
- ☐ No

Was this course *previously approved by UC* for PUHSD?
- ☐ Yes
- ☐ No
(Will be verified by Ed Services)

Meets "AP" Requirements?
- ☐ Yes
- X No

Submitted by: Maggie Maratsos
Site: Heritage High School
Date: 1/28/2020

Credential Required to teach this course:
Single Subject: Agriculture
Designated Subject: 5. Career Technical Education - Agr. + natural resources

To be completed by Human Resources only.

Signature

2/27/20
Date

Meets "Honors" Requirements?
- ☐ Yes
- X No

Unit Value/Length of Course:
- ☐ 0.5 (half year or semester equivalent)
- X 1.0 (one year equivalent)
- ☐ 2.0 (two year equivalent)
- ☐ Other:

Approvals	Name/Signature	Date
Director of Curriculum & Instruction		3/2/20
Asst. Superintendent of Educational Services		
Governing Board		

Prerequisite(s) (REQUIRED):

Ag. Biology (required)
Algebra I (required)

Corequisite(s) (REQUIRED):

None

Brief Course Description (REQUIRED):

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.To complete that whole project each student will investigate and test an Agriscience research question by formulating a scientific question related to the course content, formulating a hypothesis based on related research, conducting an experiment to test the hypothesis, collecting quantitative data, and forming a conclusion based on analysis of the data. The result of this research program will be an in depth research and experimentation paper that is technically written, based on scientific protocol, and cited using APA formatting. Additionally, students will develop and present a capstone soil management plan for agricultural producers, using the content learned throughout the course. Throughout the course, students will be graded on participation in intracurricular FFA activities as well as the development and maintenance of an ongoing Supervised Agricultural Experience (SAE) program.

B. COURSE CONTENT

Course Purpose (REQUIRED):
What is the purpose of this course? Please provide a brief description of the goals and expected outcomes. Note: More specificity than a simple recitation of the State Standards is needed.

This course needs to be updated to become better aligned with NGSS standards. While the current Ag. Chemistry course is currently a UC-approved D Lab course, this newer curriculum will add in more opportunities for students to learn both about agriculture and about chemistry through new labs and units, all of which focus on getting students to think critically and apply their knowledge in real-world scenarios, in keeping with the NGSS philosophy of preparing students to problem-solve and approach scientific problems using systematic and rational thinking.

Course Outline (REQUIRED):
Detailed description of topics covered. All historical knowledge is expected to be empirically based, give examples. Show examples of how the text is incorporated into the topics covered.

(See attached Course Pacing Guides, which covers the major topics that will be discussed during the course, as well as the objectives for each topic)

Writing Assignments (REQUIRED):
Give examples of the writing assignments and the use of critical analysis within the writing assignments.

Agriscience Fair Project - Gives students an opportunity to utilize the scientific method and apply as it as they develop their own experiment; they will test a hypothesis, develop a procedure, record their data, and publish their conclusions. The students will write a research paper, which provides background knowledge on the reasoning for their hypothesis. Students are to create a science fair display that showcases their inquiry. Students will also submit a written 10-15 page report of their research and testable hypothesis, procedures, data, results, and conclusion.

In-Class Lab Write-Ups - Students will be expected to form a hypothesis for every guided inquiry activity or lab that we do in class. This means writing up their procedure, their materials list, and conducting research on their particular question before doing the experiment in class. After each experiment or activity concludes, students will be expected to summarize their findings and data in a full lab report, using a rubric created by the teacher to help them remember which crucial components to include in their report. Students will be instructed how to use proper APA formatting when citing sources and how to write scientific papers (compared to expository essays). See multiple examples below under "Key Assignments."

INSTRUCTIONAL MATERIALS (REQUIRED)	
Textbook #1	
Title: World of Chemistry (Current textbook at sites)	Edition: Second
Author: Zumdahl, Zumdahl, & DeCoste	ISBN: 0-6180-56276-1
Publisher: McDougal Littell	Publication Date: 2007
Usage: X Primary Text ❑ Read in entirety or near	
Textbook #2 (None)	
Title:	Edition:
Author:	ISBN:
Publisher:	Publication Date:
Usage: ❑ Primary Text ❑ Read in entirety or near	

Supplemental Instructional Materials *Please include online, and open source resources if any.*

UCCI Ag. and Soil Chemistry resource folder
(Google Drive file, shared between Ag. teachers in the state)

Agriscience Fair curricular code
Available online at www.calagteachers.org

Funding Sources: Ag. Incentive Grant, Perkins funds (for maintaining the program), and district funds (for start-up costs, like lab supplies).

Estimated costs for classroom materials and supplies (REQUIRED). *Please describe in detail.*
If more space is needed than what is provided, please attach backup as applicable.

Cost for class set of textbooks: $0 (Using current textbook)	Description of Additional Costs: Miscellaneous lab supplies include plastic cups, laundry detergent/soap, brown sugar, measuring cups, cotton balls, grass/plant seeds, pipettes, pea gravel, powdered Jell-O, white bread, seed trays, etc.
Additional costs: Soil Nutrient Lab Testing Kits: $33.95 x 6 = $203.70 Glassware: $182.40 (see breakdown below) -Graduated cylinder packs = $19.45 x 6 = $116.70 -Beaker packs = $10.95 x 6 =$65.70 -Soil moisture/pH meters = $16.95 x 6 = $101.70 -Hand lenses = $1.95 x 36 = $70.20 -Water quality nitrate/nitrite test strips = $19.95 x 2 = $39.90 Miscellaneous Lab Supplies: $500.00	
Total cost per class set of instructional materials:	$1,097.90

Key Assignments (REQUIRED):

Please provide a detailed description of the Key Assignments including tests, and quizzes, which should incorporate not only short answers but essay questions also. How do assignments incorporate topics? Include all major assessments that students will be required to complete

Soil Structure and Composition Mini-Lab – Calgon Testing
Students will learn that soil is composed of different size particles at varying percentages by conducting an experiment where students separate, examine and identify the major components of soil to better understand how these components give soil its unique physical characteristics. Students will learn to measure the percentage of sand, silt, and clay in a soil sample. Soil samples should be collected in the course of a walking field trip where students will take samples from varying locations on the walk. Students will mix one cup of soil sample with laundry detergent powder in a mason jar in order to dissolve the soil aggregates and keep the individual particles separated. Once the soil sample mixture sits for three days, students will measure and determine the percentage of each particle within their specific soil sample. Students will write a lab report to summarize what occurred throughout the experiment, their data, and analysis/conclusion.

Water and Soil Management Mini-Lab – Water Percolation
Students will learn how to design a scientific experiment through proper scientific method and how to develop a research proposal. Students will be put into groups to produce a mini-proposal which will include the specific water percolation problem/question they will research for this lab, three literary research references, a hypothesis and scientific procedure. Students will also learn how soil composition impacts the speed of water percolation or amount of water absorption by conducting the experiment they designed. Students will create a lab report that includes their data and analysis/conclusion. The lab not only develops students ability to write a proposal and a scientific experiment, but exposes them to the relationship between water and soil management.

Plant and Soil Management Mini-Lab – Nutrient Uptake
Students will learn that plants utilize nutrients in soil to grow and develop. Each student will bring in a soil sample from their yard to utilize in this lab. They will divide the sample into two pots, one that will be a control sample and the other will be amended with animal manure compost. They will test the nutrients of these two pots of soil with a standard soil testing kit in order to record the levels of Nitrogen, Phosphorus, and Potassium in their control and amended samples. A bean seed will be planted in each pot of soil to germinate and grow over the course of a two week period. Throughout the two weeks, students will be recording quantitative data on seed germination, plant growth, and soil nutrients. After analyzing their data, students will determine how much of each nutrient was utilized by the bean plant. A lab report will be written to summarize what occurred throughout the experiment, their data, and analysis/conclusion.

Animal and Soil Management Mini-Lab – Animal Manure Amendment
To build on to the learning of nutrient uptake in the previous lab, students will extend their data analysis to make conclusions on why the bean plant in the amended soil sample had more optimal growth over the past two weeks than the bean plant in the controlled soil sample. This extended analysis of their data will allow the students to learn that animal waste can be composted and used as a soil amendment to increase soil nutrients for optimal plant growth. A lab report will be written to summarize what occurred throughout the experiment, their data, and analysis/conclusion.

Technology Mini-Lab – Soil Moisture Testing
Building on the learning of soil composition in the Calgon lab, in this mini-lab, students will learn that the moisture levels in soil vary depending on the soil composition through the use of soil moisture sensing equipment. Students will learn how to operate a soil moisture sensor by testing the moisture levels in various soils. Students will return to the locations where soil samples were collected for the Calgon testing lab in order to test the moisture levels of those specific soils. They will use their data from the Calgon testing lab alongside the data from the soil moisture tests to determine how the composition of the soil impacts the soil moisture levels. A lab report will be written to summarize what occurred throughout the experiment, their data, and analysis/conclusion.

Agriscience Research Project Proposal
The key assignment for this introductory unit will be writing a research proposal for the student's planned Agriscience Project. To guide the students in deciding their agriscience research questions/problem, the mini lab experiences completed in this unit should be utilized.The written proposal will include their chosen problem/question that they will be researching and investigating, five pieces of literary references, and the steps to complete for their research project. This assignment marks the first in a series of assignments that will be necessary for students to complete in order to successfully complete their agriscience research project.

Sedimentary Rock Lab
In this activity students will model how sedimentary rock is formed by simulating weathering and erosion. Because

sedimentary rock is the parent material for major components of many high quality soils, students will investigate the physical and chemical processes which create sedimentary rock. In this lab, students will use brown sugar to simulate the effect of water on soluble rock, show how water can dissolve various minerals, show how freezing water can crack porous rock, show the effects of water's impact by pouring water on sand, and use a hairdryer and sand to simulate wind erosion on copper sulfate crystals. Students will turn in a lab report that details the results of the lab and that identifies which processes are examples of physical change (water expanding in cracks to break rocks, sand particles wearing away rock, etc.), and which processes are examples of chemical change (slightly acidic water dissolving limestone, oxidation of minerals to create metal oxides, etc.).
(http://www.rsc.org/education/teachers/resources/jesei/weather/home.htm)

Collect and Test Soil Samples: Physical Properties (figure out what elements might be in them based on chemical properties)
In this lab, students will learn how to test the physical characteristics of soil, so that they can learn how these characteristics affect a soil's capabilities in later units. They will be able to assess and amend a soil to achieve a specific agricultural application. Students will collect soil samples from a variety of locations around their community. After receiving instruction in lab safety protocols, students will choose appropriate lab testing and safety equipment, and will carry out a battery of industry standard tests to determine what physical characteristics the soil samples possess. After receiving instruction in what physical properties of matter are measured in soil testing, students will use the ribbon test, and also look at physical factors such as soil texture, composition, and particle size. Students will examine the soil for presence of living organisms, such as nematodes. Based on these properties, students will hypothesize what chemical elements are present in the soil. Students will research what chemicals are prominent in the soil in their test areas, and check their hypotheses against this research. Students will turn in an annotated bibliography detailing the major findings of their research. Students will give a presentation on their annotated bibliography, and give details on where their soil came from, the lab tests they performed, the results of the tests, their data analysis, and how that analysis compared to their research.

Background Scholarly Research and Forming a Hypothesis
As they begin work on their semester-long research project, students use skills in research and forming hypotheses developed in the previous units to develop a hypothesis for their agriscience research project. Students will use credible sources to conduct background research on the agricultural issue they are investigating by reading and deconstructing scholarly journal articles to identify the key components of their agriscience research project. They will use this research to generate a testable hypothesis related to the scientific problem they have identified. The hypothesis developed by the student will be constructed with the independent and dependent variables in mind, and ultimately reviewed by the instructor.

Test Soil Samples: Chemical Properties
In this lab, students will learn how to test the chemical characteristics of soil, so that as they learn how these characteristics affect a soil's capabilities in later units, they will be able to assess and amend soil to achieve a specific agricultural application. Students will test the soil samples that they collected for the previous lab to determine the chemical properties of the samples. After receiving instruction in lab safety protocols, students will choose appropriate lab testing and safety equipment. After learning what chemical characteristics of soil are commonly tested, what reactions occur in the testing process, and how these tests are performed, students will carry out a battery of industry standard tests to determine chemical characteristics, such as pH, nitrogen levels, potassium levels, phosphorous levels and presence of micronutrients. Students will use their chemical tests to compare what chemical elements they found in the soil with what they hypothesized based on physical characteristics, and what they found in their research. Students will turn in a lab report which details where their soil came from, the lab tests they performed, the results of their tests, and the analysis of their results as compared to their findings in the previous

assignment.

Experimental Design and Conducting Experimentation
Students continue work on their semester-long agriscience project by constructing an experimental design to test the hypothesis they developed in earlier in this unit. A written experimental design should be constructed consistent with scientific protocols using the systematic approach outlined in the previous units. Students will have their experimental designs reviewed by professional contacts (industry experts, agricultural instructors, local growers/producers, researchers or university representatives). After validating the design using the peer review process, students will move to the experimentation phase of their research. Experimental designs should include replicates, control groups, and determine the variables to be controlled and how. Additionally, a determination should be made as to the type of data that will be collected and in what ways, with the emphasis placed on quantitative data or quantifying data that is qualitative in nature. Students will use their experimental design to test their hypothesis. Raw data should be recorded using a field book or electronic device.

Creating Soil Maps
Students will take the soil analysis results from the previous assignments to construct a soil map of their local area. Based on the physical properties, such as soil texture, composition and particle size, the chemical properties, such as pH, nitrogen levels, micronutrient levels, etc., and the specific location from which the soils came, students will categorize the soil samples and the class will construct a comprehensive soil map of the local area. Students will then compare their map to existing soil maps, and analyze the similarities and differences with the previous USDA-NRCS maps.

Soil Management Project
The soil management project, which students begin in unit 2, will be ongoing throughout the length of the course. The teacher will procure samples of soil from a variety of local farms and these samples will be kept as individual soil plots, or can be kept in plastic containers. Students will perform a variety of tests on these soil samples throughout the course in order to determine the characteristics that the individual samples possess, to analyze how these characteristics impact agricultural outcomes, and how amendments can be made to the soil samples in order to achieve a desired outcome. In this unit students will use the skills they learned in the previous labs to test and record the physical and chemical characteristics of the soil, and identify organisms living in the soil. Students will keep ongoing records of the data they collect during each of the units learning labs. This data will include information about the physical and chemical characteristics of their soil sample, results from testing pH, moisture, nutrient levels, water holding capacity, ability to grow target crops, and other factors in subsequent units.

Soil Erosion and Runoff Lab
Using soil plots from the previous labs, students will analyze how soils with vegetation (including organic matter) have a greater water holding capacity and less runoff than soils without vegetation by collecting runoff water from each plot and testing not only the amount of water collected from each plot, but also the percent of solids collected from runoff from each of those plots. Students will complete their lab write up to emphasize their understanding of these key concepts. Students' lab reports should include qualitative and quantitative observations of the composition of runoff from the soil plots. They should analyze this data to draw conclusions about the water holding capacity of the soils and should discuss the intermolecular interactions which allow soil to hold water at the molecular level. This assignment prepares them for decisions that will be made in their capstone project of creating a soil management plan.

Water Quality Testing

Students will begin by examining properties of subatomic particles and will create models to illustrate bonding of hydrogen and oxygen, accounting for the polarity of the water molecule. The focus of this unit will continue to develop an understanding of how hydrogen bonds give water a number of properties that allow it to percolate through soil, adhere to pollutants and transpire through plants.
https://www.lcmm.org/education/resource/on-water-ecology/worksheet-water-quality-testing.pdf

Above is the link to the lab where students will test water samples from various sources throughout their community to determine the quality of the water. They will test and record data on pH, phosphates, nitrates, dissolved oxygen, and turbidity. Students will then analyze this data to draw conclusions on what can be done to improve the quality of the water. Students should also indicate what steps can be made in agriculture to protect water quality and ensure a safe water source for the community. Students will make a presentation to the class that summarizes their lab procedure, results, and conclusions. To extend learning, the group that has the most thorough presentation can present their findings to the School Board, local Farm Bureau, or any other local organization.

Analyzing data, interpreting data and forming conclusions.
Students will determine the best methods for organizing the data from their semester-long Agriscience Project by creating data tables. The skills in analyzing and interpreting data used during Key Assignments One and Two in this unit will be applied to the final agriscience research project. Students will make similar determinations on their Agriscience research. Students will use mathematical principles to synthesize their data, calculating a mean. Furthermore, a statistical analysis of the data will help the student determine if the results are due to chance or the independent variable that was tested. Students will choose the best way to present their data using graphs they believe will most effectively demonstrate their findings, and will further summarize what each graph shows. Finally, students will interpret the data and formulate conclusions based on the results. In the written conclusion, students will use their data to either accept or reject the original hypothesis. Conclusions should be directly supported by the data and by previous research. Students will also identify the limitations of their research, improvements that could be made to the experimental design, as well as future studies that may be conducted that relate the study at hand.

Tillage Practices and the Impact they have on Runoff, Erosion and Soil Chemistry
Students will explore how chemical bonding, chemical reactions and chemical equilibrium are demonstrated through the relationship between tilled soil and water runoff. Students build upon their knowledge of atomic structure to explore the various forms of chemical bonding that takes place between atoms of different elements as well as the role of valence electrons. To deepen understanding of chemical interactions, students will investigate both the physical and chemical changes that take place during tillage.

Students will utilize locally sourced soil samples at both pre-tillage and post-tillage intervals to compare the effects of tillage on the physical and chemical nature of soil. Ideally, multiple tillage types will be examined including conventional tillage, deep ripping tillage and conservation tillage. Soil pH, effective cation exchange capacity, soil organic carbon, and soil nutrient levels will be measured in addition to an analysis of the physical structure of the soil. Examination of the physical structure can allow students to predict potential erosion and runoff issues.

Students will then develop suggestions for best tilling practices by using GPS and topographic maps to determine the natural slope of a given plot of land. They will be asked to design the most efficient "tillage" for this plot to conserve water, prevent soil erosion and cause the least disturbance to soil and water bonding. Students must explain in a written report, including a detailed diagram, why they selected the design they did and how it will be the most beneficial for the environment using conservation techniques for the soil and water as learned in this unit. They will also explain why the alternative designs would be poor choices.

Groundwater Contamination and Aquifer Lab
Students will demonstrate how aquifers filter different contaminants by constructing a model of an aquifer and testing how groundwater contamination occurs by using common agricultural contaminants. They will analyze two different types of aquifers and determine which type they would want to place a well into and why. Students will explain how the size of the pores affects the intermolecular interactions between contaminated water and the rock, and how this in turn impacts how well an aquifer can filter out contaminants.

Students will examine how the pH of different solutions is directly affected by soil type and aquifer porosity. Students will model this by capturing water that comes through their aquifer model. Students will then determine the concentration of this type of solution through a standardized titration experiment.

Once they have used their models as a means of understanding how easily groundwater can be contaminated, they will complete their conclusion and create a multimedia production in the form of a TED talk or Infomercial that educates their community on what agriculturists do and can do to improve water quality in their local area. They will present their productions to a panel of judges and the winners will have their video/multimedia presentation broadcast school-wide.

Irrigation Practices in Agriculture
Students will understand how evaporation (due to temperature) and soil type plays a huge role in the irrigation methods and practices employed in the agriculture industry. Students will be given 3 different soil types. Students will divide these 3 soil types into 9 different samples; 3 of each in a different setting, but they will receive the same amount of water to simulate "irrigation". Students will hypothesize what they think will happen based on soil type and temperature with regard to moisture retention and how this will impact decisions in irrigation selection. In the control group the 3 soil samples will be placed outside. In test group #1, 3 samples will be placed under a heat lamp to simulate an environment with a hotter ambient temperature. In test group #2, 3 samples will be placed in a location cooler than your outside temperature. In all 3 of the test locations students will water all of the samples with equal amounts of water. The following day students will test the moisture content of all soil samples using a Kelway Soil Acidity and Moisture Meter to determine the effects that temperature and soil type had on moisture retention. Using this data, students will then complete the lab write up and finish a conclusion by summing up how this lab impacts irrigation practices.

Semester One Capstone Project
Students will submit their agriscience research in a written paper, and it will include the following components: problem/purpose, background research, hypothesis, methodology, results/data, and discussion/ conclusion. The paper will be written using skills associated with technical and scientific writing, for example, refraining from the use of personal pronouns or keeping discussion limited to what the research and data suggest rather than personal opinion and bias. APA format will be utilized to reference and cite sources. The project and its findings will be shared with the class in an oral presentation.

Plant Requirements from Soil Lab
Students will demonstrate their knowledge of plant growth requirements by creating a controlled experiment to compare the difference between natural and synthetic fertilizers on plant growth. Students will make qualitative and quantitative observations of plant growth and analyze their data in order to draw conclusions regarding the availability of nutrients and the practical application for crop growers. Fertilizers are identified with particular isotopes and as part of the assignment, students will describe nuclear processes and radiation, describing their methods of use in determining fertilizer application in commercial agriculture. Students will then create a written recommendation to a local crop producer regarding which type of fertilizer to use for their farm in order to achieve

production goals, highlighting chemistry concepts as a fundamental part of the assignment.

Optional extension: Students can analyze the amounts of fertilizers needed in order to reach the desired amount necessary for plant growth and determine whether the addition of fertilizers is cost effective.

Soil Management Project
Students will analyze their data collected from unit 2 and determine which crops can be grown based on the current physical and chemical properties of the soil. Students will make recommendations for soil amendments which would increase the nutrient availability of the soil in order to grow a desired crop. Students should consider how pH, and chemical equilibrium will impact the availability of nutrients in the soil in their recommendations. Students will then plant a crop from a given list of cover crops (clover, grasses and legumes) in their soil test plot, allow it to grow and then retest the soil to see if there is a difference in the nutrient concentrations. Students will incorporate their knowledge of biogeochemical cycles into their lab report and will provide an explanation of how nutrients are being transferred from the soil to the plants. The research and experimentation conducted in this project will be added to their Soil Management Capstone Project.

Plant and Soil Interactions
Students will compare their nutrient values from the previous project with other groups during a classroom discussion. Students will analyze the data and develop explanations for why there is a difference in the amount of nutrients the plants extracted from the soil. Students will then revisit the Soil Erosion and Runoff Lab from Unit 3 and measure the amount of runoff and soil erosion that occurs on each of the cover crops and compare the data to the data collected from Unit 3. Students will communicate their results in a lab write up.

Nutrient Deficiencies in Livestock
Students will examine the correlation between soil and plant nutrient levels with health problems in livestock. Using their knowledge of solutions and concentration, students will identify soil nutrient deficiencies in a geographic area. They will relate the nutrient deficiencies with livestock diseases. For example, if an area has a deficiency in selenium, students will identify problems such as white muscle disease in calves and lambs. Working in groups, the students will analyze a case study on selenium deficiencies in cattle and offer a solution and/or design a system to prevent or correct a mineral deficiency in livestock caused by a soil deficiency. Their analysis will be presented in a written report.

Optional extension to this assignment could include testing other nutrient deficiencies, such as copper toxicity, and reporting these findings in a group oral presentation using the case study as an example.

Livestock and Water Quality
Students will examine the nutrients present in animal waste and identify possible environmental contaminates in the waste. To examine the effects of water runoff from livestock facilities, students will design a controlled experiment to test water samples from soils exposed to livestock for nitrates, phosphate, heavy metals, pH, dissolved oxygen and other factors. Students will utilize their previously collected soil samples or soil plot and design a model to simulate water run off from a livestock production facility. Alternately, students will test water runoff samples from existing livestock facilities. At the conclusion of the experiment, students will provide a written recommendation to a county land use commission with a protocol for the optimal use of the animal effluent.

Livestock Waste Management
Students will examine the challenges involved with livestock waste management. The problems may include ammonia emissions, phosphorus runoff, nitrate leaching and heavy metal runoff. The instructor will provide a

problem and scenario that relates to livestock waste management from an agricultural operation. Students will research the problem and design a system or solution. For example, if a school builds a school farm and raises 10 head of cattle in confinement, how will the waste be handled? The students will consider factors such as environmental concerns, health and safety regulations, amount of waste produced, reactivity of the waste products, uses for the waste, possible cost and labor requirements.

Soil Management Project
The soil management project, which students begin in unit 2, will be ongoing throughout the length of the course. In this unit, students will identify the nutrient deficiencies or toxicities present in the soil samples that might influence livestock production. Students will develop a written proposal for the tested soil, including soil amendments, fertilizers and application of animal waste or changes in livestock management practices to address these deficiencies or toxicities. As part of the recommendation process, students will examine the use of animal waste as a method of enhancing soil quality, using background knowledge of nuclear processes to describe variability in nutrient availability in uptake. For any toxicities present, students will examine the chemical profiles of the elements and recommend strategies for resolving agricultural issues for those elements. Students will use these soil management profiles as a component of their final course project as well as use them for subsequent units.

Phytoremediation Lab
Students will learn the about the remediative effects of plants in the uptake of soil contaminants, in this example, reducing soil salinity. Students will research saltwater intrusion causes and implications, research phytoremediation, develop a hypothesis, design an experimental procedure, identify safety procedures specific to this experiment, collect and analyze data, and formulate conclusions. Through these steps, students will determine which types of plants are best in phytoremediation of saline ("halophytic" or salt loving plants) and the maximum amount of saline which can be removed from the soil in this way.

Possible extension: Compare efficacy of procedure with different soil types
Students will complete a formal lab write-up.

Tillage Protocols: Impact on Soil Structure and Soil Sustainability Lab
The purpose of this lab is to determine the effects of tillage practices on soil sustainability and plant growth. Using a prepared mini-plot with all three tillage examples (conventional, no-till, and low till) soil structure, students will measure and compare soil fertility, water holding capacity,and percolation. Students will analyze and graph their data, explain the implications of the each of these tillage systems with respect to soil and water sustainability and extrapolate those results to the effect of tillage practices affect on plant health. Students will create a poster to illustrate the benefits and drawbacks of each tillage system with respect to Soil-Plants-Water.

Land Use Planning Model
Student groups will make soil/land management decisions based on specific agriculture and land use restrictions on pieces of land such as large urban gardens, range management, forest management, and farmlands. Students will use their knowledge of physical and chemical properties of soil in regards to plants, animals and water to highlight the importance of sustainable agriculture. Getting a land use plan approved and in place with multiple interest groups is complicated and relies on the checks and balances to determine the success of the project. Each student in the group needs to take on a specific role in order to determine their Land Use Plan (such as conservationist, developer, owner, law enforcement, Department of Public Works, Anthropologist, City Planner, etc.). Groups will then prepare a presentation to present their plan. This presentation could be presented to the class and instructor or even community/local industry members.

Agriculture Issue Debate and Policy Proposal
Students will begin by conducting secondary research using industry journals into the global use of methyl bromide as a chemical soil sterilant. Students will examine the pros and cons of the use of methyl bromide in terms of manipulations to the chemical profile of soil, microbiology, effects on groundwater, runoff challenges and effects on agricultural productivity. Research should highlight chemical reactions as the primary point of focus. Students will then be assigned a perspective related to the methyl bromide investigation (runoff or microbiology, for example) to represent in the debate, using their list of chemistry- and agriculturally-focused pros and cons to inform their contributions. Students will end the debate with a comprehensive analysis of the issue of methyl bromide use in agriculture from multiple angles in order to develop a model policy for their county regarding the possible use of methyl bromide in agricultural applications.

Soil Management Project
The soil management project, which students began in unit 2, has continued throughout the length of the course. At the end of Unit 6, students will incorporate knowledge gained from all previous labs, and the conclusions drawn from the Phytoremediation and Tillage Protocols: Impact on Soil Structure and Soil Sustainability Labs to test, analyze, treat and/or modify soil structure and fertility for specific usage/in order to achieve desired outcomes. This work will be used as evidence in the Soil Management Capstone Project and will also aid in drawing the final conclusions of the year long research and experimentation.

Capstone Project and Portfolio
Soil Management Capstone Project
As the final course capstone project, students will 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. Students will 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.

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.

Instructional Methods and/or Strategies (REQUIRED):

Please list specific instructional methods that will be used.

Warm Ups - These activities will take place during the first five minutes of class and serve as a transition activity to prepare students for what they will be learning that day in Environmental Horticulture Science.

Direct Instruction Using PowerPoint Presentations, Cornell Notes, and Cloze Notes - Our students participate in mini-lectures to provide students with explicit instruction in key learning on a regular basis. These lectures are

intended to preview learning material in advance of laboratory activities or to reinforce phenomenon following an exploratory experience. Students are always expected to take notes using either Cornell or Cloze formats and to be active, participants in the lecture.

Lab and Inquiry Activities - As previously described, laboratory activities include a full scientific inquiry process where students generate hypotheses, follow procedures, collect data, and generate conclusions from that data. Students will be expected to report their findings in a lab report that requires students to report their results and data using the scientific method. Therefore, the students' lab reports will have the following sections: formulating hypotheses, collecting data, reporting their results, and using the data to validate or disprove the hypothesis they formed in a conclusion. Being that chemistry is a laboratory science area, the primary instructional strategy used to deliver curriculum are hands-on, performance-based methods, with experiential learning possibilities through the laboratory's events. This method of instruction allows students to practice the concepts and see them in action, which research suggests leads to improved retention and ability for application. Another key instructional strategy used is interactive learning, which allows students to manipulate content in various ways and form cognitive anchors. For example, there are opportunities for students to engage in role-playing, debates, discussion, and group projects.

Research Papers - It is a thesis-driven exploration of thoughtful reading on a particular subject. The reading material may come from several sources. The purpose is to find and compile data, to participate in an exploration of the data, to make original observations, to show relationships between data, and to make evaluations on a subject. Students will write papers on various subjects throughout the year that will reinforce the main concepts in Horticulture.

Small Groups - Frequently students work with peers or teachers in small groups to reinforce concepts and to ensure mastery. Small groups may engage in academic discourse around a particularly challenging problem or vexing application of a horticulture concept. Students who struggle on a particular warm-up may meet in a small group with the teacher while other students complete independent work. Small group instruction is a critical tool in differentiating curriculum for students.

Video Clips, Music, and Other Multimedia - To build students' understanding of how chemistry concepts can be recognized in the world, our high school students leverage technology to see examples of phenomenon that may be hard to replicate in the classroom or to provide experience in manipulating aspects of those phenomenons. These multimedia tools provide students with strong personal connections and help to provide necessary scaffolds for student learning.

Socratic Seminars and Discussion - At our high school, we believe that a key method of demonstrating competency and understanding of curriculum content is the ability to participate in academic conversations where students are able to discuss the content, use evidence to support their thinking and opinions, and to build on the conversations of others. Socratic Seminars and discussion provide opportunities to assess student understanding of the scientific concepts they have learned.

Student Reflections - Students will complete self-assessments to build internal understanding of their mastery of core concepts within the prior week's lessons, to build an individual plan for gaining mastery where it may not yet exist, and to link the learning of the week to prior concepts.

Vocabulary Manipulative (All Standards) - Manipulatives will be used to introduce vocabulary during every unit of the course. These manipulatives will include terms and definitions on separate cards. Students will organize the cards so the term is matched with the proper definition. Manipulatives will also be used to help students balance

equations.

Foldable (All Standards) - During each unit of study, students will create foldables using unit vocabulary and/or major concepts. Foldables are 3D graphic organizers. These foldables will also serve as a study tool for students.

Test Reflections and Corrections (All Standards) - Students will analyze their performance on all assessments. They will identify mistakes, make corrections, and determine why they chose incorrect answers. They will also write a short reflection on how they can improve their performance in the future.

E-Moments - These are creative ways of introducing and/or reviewing topics or vocabulary covered in class that often involve verbal or kinesthetic response by the students, rather than just having them do review worksheets or reading from a textbook. This could involve them playing review games, creating their own graphic organizers, writing short stories that illustrate a concept, or even acting out a key concept in a skit.

Assessment Methods and/or Tools (REQUIRED):

Please list different methods of assessments that will be used.

Student learning is continually assessed throughout the teaching of the unit through the following:

Daily, Informal Assessments - These assessments are used to gauge students mastery of discrete concepts taught during a specific class period. Informal assessments during class period (thumbs up/thumbs down, fist of five, using equity cards to question students, exit tickets, etc.) will be frequently used during every unit of study. Homework and problem sets will be regular assignments as well.

Warm-Ups (Daily Journals) - Review prior learning at the start of each lesson. Students complete this as soon as the bell rings so teacher can take attendance.

Regular Quizzes - These assessments are administered to gauge student mastery of integrated concepts after several days of instruction. These assessments are both formative and summative, providing early information regarding gaps in students' ability to integrate learning across discrete concepts and providing evidence of student mastery. There will be approximately 2-3 quizzes per unit of study. Assessments will include a mixture of comprehension and applied problem-solving depending on the content of instruction in the preceding weeks.

Regular Reflections - Students will regularly submit a written reflection in which they must identify facts from memory, reflect on how the laboratory experiment permitted them to further learn the learning objectives for the week and also ask questions about the content as they reflect on their learning. Students enrolled in the regular college preparatory course are only expected to write a reflection for every chapter just prior to the chapter assessments.

Research Papers - Research papers will be evaluated against the rubric set forth by the California Ag. Teachers' Association Curricular Code for the statewide Agriscience Fair. Students must demonstrate their ability to research and translate their thoughts, utilizing technical scientific language while keeping the scientific method in mind. Students must demonstrate an ability to read non-fictional material, as well as incorporate their own knowledge and data to make their papers stronger. There are several writing assignments throughout the school year to prepare students for the upcoming Common Core and Next Generation Science Standards. Students will also be required to

write a research paper in which they research current and relevant applications of chemistry in the vast field of agriculture, food, and environmental sciences. Students will report their findings to the class in an oral presentation. One research paper must be completed every semester.

Unit Exams - These assessments are administered to gauge students mastery of an entire unit of study for summative evaluation purposes. Unit exams include assessments of student mastery of vocabulary, ability to solve problems, and to explain the chemistry concepts that are core to the unit of study. Questions will include comprehension, applied problem-solving and integrative knowledge to assure that students understand the unit of study in all of its complexity.

Semester Final Exams - Twice a year, students will complete a cumulative exam which requires students to demonstrate mastery of core concepts learned in each unit. The semester 1 exam will address Units 1, 2, and 3. The semester 2 exam will address all units, with a greater proportion of questions coming from the second semester content.

Supervised Agricultural Experience - All agricultural students must have a Supervised Agricultural Experience (SAE) project. Students with an SAE learn by doing. With help from their agricultural teachers, students develop an SAE project based on one or more SAE categories:

- *Entrepreneurship* - Own and operate an agricultural business.
- *Placement* - Get a job or internship on a farm or ranch, at an agriculture-based business, or in a school or factory laboratory.
- *Research and Experimentation* - Plan and conduct a scientific experiment. (e.g. Determine whether the phases of the moon affect plant growth, or test and determine the efficacy of different welding methods.)
- *Exploratory* - Explore careers in agriculture by attending an agriculture career fair, or creating a report or documentary on the work of a veterinarian.

Students must submit their California Agriculture Record Book as evidence of completion of their SAE requirement. Students' final grade will depend 10% on the completion of their SAE project. All students enrolled in an agricultural class must have a Supervised Agricultural Experience (SAE) project that relates to agriculture. Students can choose from a variety of projects and students get prior approval from the instructor to see if a project demonstrates quality, quantity, and relevance to agriculture. Students must submit an Agriscience Fair Project as their SAE. This Agriscience Fair Project is vast (10-15 pages in the final report, display, and presentation) and students must utilize both semesters to complete their projects. Agriscience Fair Projects will then be submitted to the several yearly, state-wide FFA Agriscience Fair Project competitions in the spring months.

FFA Participation - Since all students enrolled in an agricultural education course are considered FFA members, all students are required to attend 3 distinctly different FFA activities per semester. This participation is worth 5% of the semester grade. All students will be provided with a FFA calendar listing all FFA activities offered. Students can meet this requirement by participating in monthly meetings, joining a committee, attending a leadership conference, joining and completing in a judging team or being a chapter officer.

COURSE PACING GUIDE AND OBJECTIVES (REQUIRED)

Day(s)	Objective	Standard(s)	Chapter(s)	Reference
	(See attached documents titled "Ag. Chemistry Pacing Guide, Revised,``"UCCI Ag. Chemistry Course Pacing Guide and Sources," and "PUHSD Ag Soil Chem Pacing Guide)			

C. HONORS COURSES ONLY

Indicate how much this honors course is different from the standard course.

D. BACKGROUND INFORMATION

Context for course (optional)
History of Course Development (optional)