

**AGRI 60 Course Outline as of Spring 2019****CATALOG INFORMATION**

Dept and Nbr: AGRI 60 Title: SOIL &amp; PLANT NUTRITION

Full Title: Soil &amp; Plant Nutrition

Last Reviewed: 1/28/2019

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	3.00	Lecture Scheduled	2.00	17.5	Lecture Scheduled	35.00
Minimum	3.00	Lab Scheduled	3.00	17.5	Lab Scheduled	52.50
		Contact DHR	0		Contact DHR	0
		Contact Total	5.00		Contact Total	87.50
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 70.00

Total Student Learning Hours: 157.50

Title 5 Category: AA Degree Applicable

Grading: Grade Only

Repeatability: 00 - Two Repeats if Grade was D, F, NC, or NP

Also Listed As:

Formerly: AG 53

**Catalog Description:**

Presents the study of soil as a growth medium for plants and a valuable natural resource. Includes physical, chemical and biological properties of soil; soil-water relationships; organisms, organic matter decomposition and soil ecosystem principles; soil reaction, cation exchange and essential nutrient cycling; synthetic and organic fertilizers; soil conservation and land management principles and practices. Performing soil analyses and making recommendations for management and crop production. Computations include land areas, liming rates, fertilizer cost, formulations, application rates, metric/unit conversions and developing customized soil reports.

**Prerequisites/Corequisites:****Recommended Preparation:**

Eligibility for ENGL 100 or ESL 100

**Limits on Enrollment:****Schedule of Classes Information:**

Description: Presents the study of soil as a growth medium for plants and a valuable natural resource. Includes physical, chemical and biological properties of soil; soil-water relationships;

organisms, organic matter decomposition and soil ecosystem principles; soil reaction, cation exchange and essential nutrient cycling; synthetic and organic fertilizers; soil conservation and land management principles and practices. Performing soil analyses and making recommendations for management and crop production. Computations include land areas, liming rates, fertilizer cost, formulations, application rates, metric/unit conversions and developing customized soil reports. (Grade Only)

Prerequisites/Corequisites:

Recommended: Eligibility for ENGL 100 or ESL 100

Limits on Enrollment:

Transfer Credit: CSU;

Repeatability: Two Repeats if Grade was D, F, NC, or NP

## **ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:**

<b>AS Degree:</b>	<b>Area</b>		Effective:	Inactive:
	C	Natural Sciences	Fall 2019	
<b>CSU GE:</b>	<b>Transfer Area</b>		Effective:	Inactive:
	B1	Physical Science	Fall 2019	
	B3	Laboratory Activity		
<b>IGETC:</b>	<b>Transfer Area</b>		Effective:	Inactive:
<b>CSU Transfer:</b>	Transferable	Effective:	Fall 1981	Inactive:
<b>UC Transfer:</b>		Effective:		Inactive:

### **CID:**

CID Descriptor: AG - PS 128L Introduction to Soil Science

SRJC Equivalent Course(s): AGRI60

### **Certificate/Major Applicable:**

Both Certificate and Major Applicable

## **COURSE CONTENT**

### **Outcomes and Objectives:**

Upon completion of this course the student will be able to:

1. Collect, prepare, and test a representative soil sample for a variety of crop and forest environments and landscape situations.
2. Measure parcels using a variety of common units of distance measurement and calculate land areas in acres and hectares.
3. Compare USDA Soil Survey maps and data with actual soil conditions encountered in field observations.
4. Define and cite examples of the five soil-forming factors: parent material, climate, topography, living organisms and time.
5. Identify examples of the three classes of soil-forming rocks: igneous, sedimentary and metamorphic.
6. Evaluate soil productivity based on Land Capability Classification and revised Storie Index ratings.
7. Compare the functions of the four physical components of soil: air, water, mineral solids, organic matter.
8. Distinguish the attributes of the typical horizons within a soil profile.

9. Relate water holding capacity, aeration, permeability to plant roots, and drainage characteristics to sand, silt and clay content of soils.
10. Analyze soil texture using "feel" method and classify soils by percent sand, silt and clay content using the soil textural triangle.
11. Explain the natural processes that result in the cementing of sand, silt and clay particles into secondary aggregates and recommend practices that enhance or maintain good soil structure.
12. Relate soil moisture tension terminology to field and nursery container soil conditions.
13. Predict water movement in soils with non-uniform textural and structural characteristics.
14. Summarize the cation exchange process in relation to plant nutrient availability.
15. Describe the sources of soil acidity.
16. Describe harmful effects of pH imbalances and recommend materials and methods for managing soil pH.
17. Categorize the major groups of soil microflora and microfauna in the soil ecosystem.
18. Explain the beneficial significance of nitrogen-fixing bacteria and mycorrhizal fungi.
19. Select organic amendments according to carbon:nitrogen ratio characteristics.
20. Explain mineralization and immobilization of nutrients.
21. List the factors that influence decomposition and describe the process of decomposition of organic matter.
22. Select materials and recommend management practices for composting.
23. Compare and contrast artificial soil media such as peat moss, perlite, vermiculite, coconut coir and rice hulls.
24. List and describe plant uses and deficiency symptoms of the essential mineral nutrients.
25. Interpret fertilizer labels, predict suitability and effectiveness of fertilizers for a variety of crops.
26. Analyze the attributes of synthetic and organic fertilizer materials.
27. Recommend fertilizer application methods appropriate for various crop and landscape scenarios.
28. Evaluate various cover crops for perennial and annual cropping systems.
29. Define accelerated erosion by wind and water and describe control methods.
30. Explain how the Natural Resource Conservation Service (NRCS) and Resource Conservation Districts (RCDs) assist landowners in implementing soil conservation practices.

## **Topics and Scope:**

### **I. Soil formation**

#### **A. Classes of common soil-forming rocks**

1. Igneous
2. Sedimentary
3. Metamorphic

#### **B. The 5 soil-forming factors**

1. Parent material
2. Living organisms
3. Climate
4. Topography
5. Time

#### **C. Soil weathering processes**

1. Physical
2. Chemical
3. Biological

#### **D. Basic soil components: 50% solid particles, 50% pore space**

1. Mineral particles 45%
2. Organic matter (O.M.) particles 5%

3. Air +/- 25%
4. Water +/- 25%
- E. Soil profile development and typical horizons
  1. O, A, B, C, R horizons
  2. Factors that influence the development of horizons
  3. Temperate and arid region soil profiles
  4. Profiles in various landforms and environments
- II. Soil physical properties
  - A. Texture
    1. Sand, silt and clay particles as primary soil separates
    2. Textural classification system and soil textural triangle
    3. Soil texture and related soil properties
  - B. Structure
    1. Types of aggregates and aggregate formation
    2. Beneficial effects of good soil structure (aggregation)
    3. Soil structure and associated properties (aeration, water-holding capacity, infiltration)
    4. Maintaining and improving soil structure
    5. Problems of compaction and subsurface impermeable layers
    6. Role of organic matter in aggregate formation
    7. Soil tilth and proper tillage practices
    8. Mulches
  - C. Significance of soil color and soil coloring agents
    1. Abundance of certain minerals
    2. Organic matter content
    3. Seasonal waterlogging and gleying
  - D. Temperature
    1. Moderation effects of soil on air temperature extremes
    2. Daily and seasonal variation
    3. Effects of soil moisture on temperature
    4. Effects of aspect (north vs. south facing slope)
    5. Effects on seed germination and root growth
    6. Effects of regulation of soil temperature
  - E. Bulk density and porosity
    1. Effects on aeration and drainage, permeability on plant growth
    2. Inverse relationship of BD [bulk density] and porosity
    3. Desirable BD values and factors affecting BD
- III. Soil-Water relations and water holding capacity (WHC)
  - A. Soil moisture tension conditions
    1. Saturation
    2. Field capacity
    3. Permanent wilting point (or wilting point)
    4. Available vs. unavailable water
  - B. Forces affecting water movement in soil
    1. Properties of the water molecule
    2. Saturated flow and gravitational force
    3. Unsaturated flow and capillary forces
    4. Osmotic (dissolved salts) potential differences
  - C. Soil physical conditions affecting water movement and WHC
    1. Relationship of particle size and total surface area
      - a. To water holding capacity
    2. Movement across layers of non-uniform
      - a. Texture/structure

3. Depth and consistency of profile and horizons
4. Perched water tables in soil profile and in growing
5. containers; shallow vs. deep containers
6. Texture and structure influences on infiltration,
  - a. Percolation
- D. Moisture-sensing devices
  1. Gypsum block
  2. Tensiometer
  3. Neutron probe
  4. Other conductivity meters and commercial products
- IV. Soil chemical and colloidal properties
  - A. Structure and properties of clay colloids
  - B. Humus and organic colloids
  - C. Sources of changes on soil colloids
  - D. Principles of Cation Exchange Capacity (CEC) and Anion Exchange Capacity
  - E. Cation Exchange Capacity and nutrient availability
    1. Adsorption of nutrient cations on micelles
    2. Leaching potential of mineral anions
    3. Cation exchange capacity related to soil texture and organic matter content
    4. Role of cation exchange in soil fertility
- V. Soil acidity
  - A. Acidity, alkalinity, pH and related terms pH scale
    1. Types of acidity
    2. Role of Aluminum in soil pH
    3. Desirable pH values for plant growth
    4. Effects of undesirable pH on plant growth and soil
    5. Organisms
  - B. Buffering and buffering capacity of various soils
  - C. Buffering, soil pH and plant available nutrients
  - D. Managing soil pH
    1. Liming materials, efficiency, effectiveness
      - a. Factors that influence the effectiveness of liming agents
    2. Benefits of liming acid soils, various liming materials
    3. Acidifying alkaline soils
- VI. Soil biology and ecology
  - A. Principles of diversity and stability of soil organism
    1. Populations
  - B. General groupings of macro- and micro-organisms
    1. Macro- and micro-fauna
    2. Macro- and micro-flora
  - C. Classification of organisms by energy source, presence of oxygen, feeding habits, and effects on plants (beneficial and harmful)
  - D. Symbiotic organisms
    1. Rhizobium bacteria and nitrogen fixation on legume roots
    2. Mycorrhizal fungi on roots of most plants
  - E. Rhizosphere characteristics
- VII. Organic matter decomposition and addition
  - A. Decomposition of organic material
  - B. Environmental factors that influence decomposition
  - C. Immobilization and mineralization of nitrogen
  - D. Types of organic soil amendments
  - E. Value of cover crops in O.M. management

F. Common groups of aerobic decomposing organisms beneficial to plants

G. Carbon:Nitrogen ratio of organisms and organic matter

1. Effects of C:N ratio on decomposition rate of O.M.

2. Immobilization of N by decomposing microbes

H. Composting methods overview

1. Rapid composting or hot composting

2. Pit composting or other cold composting methods

3. Worm composting

I. Composting fundamentals

1. Green, moist nitrogen materials

2. Brown, dry carbon materials

3. Temperature indications related to decomposition rate

a. Ambient

b. Mesophilic zone

c. Thermophilic zone

4. Moisture levels within 40%-60% for aerobic organisms

5. Aeration through regular turning and mixing of materials

VIII Essential mineral nutrients

A. Primary nutrients and their functions and deficiency symptoms

1. Nitrogen cycle

2. Available forms of nitrogen for plant uptake

3. Factors that influence the availability of primary nutrients

B. Secondary nutrients

C. Micronutrients

IX. Fertilizers

A. The need for and benefits of proper fertilizer use

B. Common synthetic and organic fertilizer materials

C. Speed of availability of nutrients in various materials

D. Effects on pH

E. Fertilizer labels

F. Complete fertilizers

G. Balanced fertilizers

H. Starter fertilizers

I. Calculating nutrient content, application rates and cost per pound of selected nutrients in fertilizers

J. Methods of application

K. Environmental concerns related to fertilizer use

X. Soil conservation, management and erosion control

A. Types of soil erosion

B. Significance of soil erosion and land degradation

C. Principles and practices of soil conservation and erosion control

D. Comparison of conventional tillage systems and conservation tillage effects on soil erosion

E. Progress in soil conservation

F. Natural Resource Conservation Service (NRCS) and Resource Conservation Districts (RCDs)

XI. Soil Information

A. Soil taxonomy

B. Making soil maps

C. Techniques for mapping soils

D. Soil surveys and soil reports

1. Land capability classes

2. Storie Index

## XII. Non Agricultural uses of soil

- A. Waste disposal on soils
- B. Engineering properties
- C. Recreation and consumption
- D. Reclaimed and artificial soils

### Assignment:

1. Weekly laboratory write-ups and associated homework questions.
2. In-class calculations and exercises.
3. Weekly text reading assignments of approximately 20-40 pages per week.
4. Soil survey report.
5. Mid-term and final exams.

### Methods of Evaluation/Basis of Grade:

**Writing:** Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

Lab write-ups and soil survey report.

Writing  
10 - 40%

**Problem Solving:** Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Lab write-ups, calculations and exercises.

Problem solving  
10 - 40%

**Skill Demonstrations:** All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

None

Skill Demonstrations  
0 - 0%

**Exams:** All forms of formal testing, other than skill performance exams.

Quizzes, midterm, final exam: Multiple choice, True/false, Matching items, Completion

Exams  
30 - 60%

**Other:** Includes any assessment tools that do not logically fit into the above categories.

Lab participation.

Other Category  
10 - 20%

### Representative Textbooks and Materials:

Elements of the Nature and Properties of Soils, 3rd ed. Brady, N., Weil, R. Prentice Hall, NY, 2010.

Soil Science Simplified. Kohnke, B. 4th Ed. 1995 (classic).