Greenhouse Management

Agriculture

Grade(s) 10th - 12th, Duration 1 Year, 1 Credit
Elective Course
Dual Credit

Course Overview

Greenhouse Management is a course teaching students the form and function of plant systems. Student experiences include the study of plant anatomy and physiology, classification, and the fundamentals of production and harvesting.

Students learn how to apply scientific knowledge and skills to use plants effectively for agriculture and horticultural production. Students discover the value of plant production and its impact on the individual, the local, and the global economy. Teachers are provided detailed professional development to facilitate instruction.

Scope And Sequence

Timeframe	Unit	Instructional Topics
6 Day(s)	Worlds of Opportunity	1. A World Without Enough Plants
17 Day(s)	Mineral Soils	1. Understanding Soil Properties 2. Soil Chemistry
15 Day(s)	Soilless Systems	1. Mixing Media 2. Hydroponics
32 Day(s)	Anatomy & Physiology	1. Cells: Life's Smallest Units 2. The Radicle Root 3. Stems, Stalks, & Trunks 4. Leave it to Leaves 5. Flower Power
6 Day(s)	Taxonomy	1. Sorting Out Plants
26 Day(s)	The Growing Environment	1. Plant Food 2. All Wet 3. Lighting It Up 4. Chilly Lilies
28 Day(s)	Sexual Reproduction	1. Plant Genetics 2. Pollination & Dispersion

Prerequisites

Ag Science I

Course Details

Unit: Worlds of Opportunity

Duration: 6 Day(s)

Unit Description

In this unit, students define agricultural plant industries and discover how plants impact their daily lives. Students organize plants based upon how they use them, and research potential careers they may have in agriculture.

Academic Vocabulary

Aesthetic
Agronomy
Arboriculture
Biofuel
Botany
Citrus
Climate
Crop
Cultivation
Fiber crop
Floriculture
Food
Forestry
Fruit
Horticulture
Landscape
Legumes
Marketing
Medicinal
Nursery
Orchard

Plant
Plant hardiness zone
Precipitation
Processing
Production
Research
Seed
Vegetables
Vegetation

Topic: A World Without Enough Plants **Duration:** 6 Day(s)

Topic Description (short)

In this lesson, students determine their dependence upon plants, develop a course organizational system, and investigate the plant industry and related careers. Finally students begin planning a course-long plant business project.

Learning Targets

1. People work in a variety of agricultural enterprises to produce food, fiber, and fuel, which are essential to daily life.
2. Organization and record-keeping are important to the success of a plant business.
3. Plants are used to sustain human existence by providing many essential products, such as food, fiber, fuel, and medicine.
4. Plant industries provide production and management career opportunities.

Formative Assessment

1. Research plant industries and related careers. (Activity 1.1.1)
2. Develop and keep an Agriscience Notebook to record and store information presented in classroom discussions and activities throughout the course. (Activity 1.1.2)
3. Survey their dependence upon plants. (Activity 1.1.3)
4. Begin and ongoing course project researching physical attributes and growth requirements for several species of plants. (Project 1.1.4)

Unit: Mineral Soils **Duration:** 17 Day(s)

Unit Description

Students identify and classify soils based upon various physical features including texture, structure, and color. Next students learn how these features affect how they can use the land. Students complete the lesson exploring the chemical features of soil and their impact on plant growth.

Academic Vocabulary

Arthropod
Bacteria
Bedrock
Clay
Climate
Fungi
Gravel
Ground cover
Horizon
Internal drainage
Irrigation
Leaching
Loam
Microorganisms
Mottle
Nematodes
Organic matter
Organism
Parent Material
Ped
Permeability
Porosity
Profile
Rock
Sand
Silt
Soil
Soil profile
Soil structure
Soil texture
Acid

Alkaline
Base
Buffer
Conductivity
Conductivity tester
Electrical conductivity
Fertilize
Gypsum
Hydrogen
Ion
Irrigation
Leaching
Lime
Nutrient
Organic
pH
Saline soil
Salinity
Sodic soil

Topic: Understanding Soil Properties

Duration: 12 Day(s)

Topic Description (short)

In this lesson, students determine the texture of soil and its relationship to permeability. Next, they identify organisms in soil samples. Then students measure water holding capacity, color, and porosity.

Learning Targets

1. Soil texture is a proportion of sand, silt, clay, and influences how producers use soil.
2. Texture and structure of soil horizons affect soil permeability.
3. Organisms found in soils improve soil quality.
4. Soil structure and texture influence the water-holding capacity and drainage of soil.
5. Organic matter affects the porosity and water-holding of soils.
6. Internal drainage, evidenced by color, mottling, and permeability, affects soil management decisions.
7. The structure and color of the soil profile determine the effective depth of a soil.

Formative Assessment

1.Conduct tests to determine soil texture by feel. (Activity 2.1.1)
2. Illustrate soil structure and determine how structure influences soil permeability. (Activity 2.1.2)

    - Test soil permeability to understand the relationship between the soil particle size and rate of water filtration. (Activity 2.1.5)

3. Collect and identify macroscopic and microscopic organisms found in a soil sample. (Activity 2.1.3)
4. Measure the water holding capacity of various test substances and compare data. (Activity 2.1.4)
5. Conduct an experiment to explore the relationship between the organic matter and water holding capacity of soil. (Activity 2.1.5)
6. Describe soil hue, value, and chroma and asses soils for drainage-related characteristics based on color. (Activity 2.1.6)
7. Measure the water holding capacity of various test substances and compare data. (Activity 2.1.4)

Topic: Soil Chemistry

Duration: 5 Day(s)

Topic Description (short)

Up until now the students have been learning about the visual aspects related to soil function and quality. However, what students cannot see is as important to plant growth as physical properties. This lesson explores the chemistry of soil, such as pH and salinity. Both factors influence the growth of plants by affecting the availability or absorption of water and nutrients.

Learning Targets

1. Soil pH determines the availability of nutrients required for plant growth and health.
2. The optimal pH and salinity levels required for plant growth vary among plant species, and producers adjust the levels by using chemical treatments.
3. Soil salinity concentration determines how well plants uptake water, and as a result, the ability of plants to absorb nutrients.
4. Testing of soil samples detect imbalances of soil chemistry.

Formative Assessment

1. Conduct a soil sample test to determine pH. (Activity 2.2.1)
2. Correct for acidic soil conditions using lime. (Activity 2.2.2)
3. Determine the salinity of soil by measuring electrical conductivity. (Activity 2.2.3)
4. Measure soil salinity to determine the effects of chemical fertilizers on soil salinity levels. (Activity 2.2.3)

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Unit: Soilless Systems

Duration: 15 Day(s)

Unit Description

Students explore how to grow plants without soil. They start the unity identifying the types of material found in a potting media. Then students learn how hydroponic systems work and construct their owns system for growing plants.

Academic Vocabulary

Aeration
Bark
Cubic measurement
Density
Drainage
Fertilizer
Mass
Media
Peat
Perlite
Pumice
Vermiculite
Volume
Aeroponics
Aggregate culture
Dissolved oxygen
Hydroponics
Nutrient flow technique
Neutral
Rockwool
Water culture

Topic: Mixing Media

Duration: 4 Day(s)

Topic Description (short)

This lesson will allow students to examine the properties of potting media ingredients and determine the role of each. They will also calculate container volumes of various shapes and sizes to estimate the usage potting media, which is a very practical skill for plant production.

Learning Targets

1. Potting media has specific qualities suited for container crops, such as using lightweight and inexpensive materials that provide the essential components needed for drainage and porosity.
2. There are a variety of ingredients used in potting soil that provide permeability, porosity, and fertility needed for container crops.
3. Greenhouse and nursery plant producers calculate and purchase media in cubic feet or cubic yard increments.

Formative Assessment

1. Identify components commonly used in potting media. (Activity 3.1.1)
2. Test different potting media ingredients to determine the permeability and porosity qualities of the media. (Activity 3.1.1)
Determine the percentage of ingredients found in a potting soil mixture. (Activity 3.1.1)
3. Calculate the volume of various containers using mathematics. (Activity 3.1.2)

Topic: Hydroponics

Duration: 11 Day(s)

Topic Description (short)

In this lesson, students explore the basics of hydroponics plant production. Students will take a close look at the various types of systems used and how to manage plant production in a soilless environment.

Learning Targets

1. Growing crops with a hydroponic method relies on using water with or without potting media instead of mineral soil to provide the necessary growth requirements.
2. Hydroponic crop production has advantages over traditional cropping systems, such as efficient use of space and resources.
3. Careful management and monitoring of water quality in a hydroponic system are necessary to ensure plant health.
4. Hydroponic systems provide essential growth requirements for plants in a variety of ways.

Formative Assessment

1. Examine and discuss hydroponic system components. (Activity 3.2.1)
2. List the advantages and disadvantages of hydroponics and traditional crop production systems. (Activity 3.2.2)
3. Compare the use of fertilizers, water, and media in hydroponic and traditional plant production systems. (Activity 3.2.2)
4. Design a hydroponic system incorporating the design principles of a specific type of system, such as nutrient flow, aggregate, water culture, or aeroponics. (Project 3.2.3)

Unit: Anatomy & Physiology

Duration: 32 Day(s)

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Unit Description

During this unit, students research and observe the parts of the plant and how they function together. They begin the unit examining the physical and metabolic features of a plant cell. Then they dissect and assess the physiological functions of roots, stems, leaves and flowers.

Academic Vocabulary

Aerobic
Anaerobic
Anatomy
Apical tissue
Cell
Cell membrane
Cell wall
Centrosome
Chloroplast
Cytoplasm
Dicot
Endoplasmic reticulum
Epidermis tissue
Eukaryote
Golgi apparatus
Lateral
Lysosome
Meristems
Metabolism
Mitochondria
Monocot
Nucleolus
Nucleus
Organelle
Parenchyma
Peroxisome
Phloem
Photosynthesis
Prokaryotes
Protoplast
Protoplasm
Respiration
Ribosome
Sucrose
Tissue
Vacuole
Xylem

Topic: Cells: Life's Smallest Units

Duration: 7 Day(s)

Topic Description (short)

The exploration of plant cells in this lesson will provide students an opportunity to learn each cell part and begin to understand the contribution a cell makes to the function of a plant. Students will learn about the anatomical characteristics of cells while drawing and labeling parts of a plant cell to help them to understand the function of cell parts.

Learning Targets

1. There are different classifications of cells based on their utility.
2. Plant cells are comprised of many parts dependent upon each other that have essential functions for the survival of plant tissue.
3. Plant cells contain microscopic organelles specific to plant functions.
4. Cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water.

Formative Assessment

1. Develop a pictorial representation of cell function. (Project 4.1.1)
2. Identify and label plant cell organelles. (Project 4.1.1)
Represent relationships between organelles using a graphic organizer. (Activity 4.1.3)
3. Correctly prepare slides of plant cells for viewing under a microscope. (Activity 4.1.2)
4. collect and analyze data to provide evidence of cell metabolism. (Activity 4.1.4)

Topic: The Radicle Root

Duration: 6 Day(s)

Topic Description (short)

This lesson is designed to ensure students understand how roots, stems, leaves, and flowers function. From this brief introduction, students examine specific root structures and processes. Students will learn the anatomical features of the root and how the cells, which make up

those features, are different from one another.

Learning Targets
1. A plant's root, stem, leaves, and flower are vital for plant health and growth.
2. The root has specific anatomical features responsible for anchoring the plant in the soil.
3. Plant roots use differentiated cells that perform specific functions in the root, such as the absorption of water and dissolved nutrients.
4. Plants use the process of osmosis, influenced by the turgidity of plant tissues, for the uptake of water and dissolved nutrients required for plant growth.

Formative Assessment
1. Describe the function of the major plant parts. (Activity 4.2.1)
2. Examine a root structure and sketch representations of the structural form of a root. (Activity 4.2.2)
3. Examine cell differentiation as it relates to root cells. (Activity 4.2.3)
4. Conduct an experiment to simulate the osmosis process of plant root hairs. (Activity 4.2.4)

Topic: Stems, Stalks, & Trunks
Duration: 7 Day(s)

Topic Description (short)
The major function of stems is to provide physical support for the lease and flowers of plants. However, a closer examination of stems reveals several other essential functions for plant growth, including the development of new cells and tissues. this lesson explores the internal features of plant stems that serve as the main highway for nutrients and water distributed throughout a plant system. The stem of hardwood plants, such as trees, also contains a record of growth patterns that can help determine the growing environment of the plant.

Learning Targets
1. Stems of plants provide physical support, storage of nutrients, and necessary pathways for the translocation of materials throughout the plant.
2. The majority of plant growth takes place in meristematic tissue.
3. Environmental conditions, such as temperature and precipitation, are reflected int he growth rates of plants and evidence of those conditions can be found in woody stems.

Formative Assessment
1. Identify differences between internal structures of monocotyledon and dicotyledon features. (Activity 4.3.1)
2. Compare plant survival and recovery from damage to meristematic tissue. (Activity 4.3.2)
3. Create a poster depicting the lifespan of a tree referencing environmental conditions, historical events, and stages of growth. (Project 4.3.3)

Topic: Leave it to Leaves
Duration: 6 Day(s)

Topic Description (short)
Leaves have several external and internal parts that are important to recognize. People use knowledge of external plant parts as a means to classify and identify plants. Similar to humans, each plant has its own unique set of physical features that distinguishes an individual plant from others. Internal plant parts are important for understanding physiological processes, such as photosynthesis and transpiration, that will be examined later in this course.

Learning Targets
1. Agricultural scientists use leaf characteristics to identify species or varieties of plants.
2. Leaves have several parts with differences in physical characteristics, such as shape and venation patterns.
3. Leaf cells contain a specialized pigment known as chlorophyll that is used by the plant to harvest radiant energy from the sun.
4. Leaves produce and store food.

Formative Assessment
1. Create a journal that includes sketches and identification information for 20 different species of local plants. (Project 4.4.1)
2. Identify the characteristics of simple and compound leaves. (Project 4.4.1)
3. Investigate the pigments and food storage systems found in plant leaves. (Activity 4.4.2)
4. Compare stored sugar content of leaves (Activity 4.4.2)

Topic: Flower Power
Duration: 6 Day(s)

Topic Description (short)
Flower Power provides basic knowledge and terminology of flower parts that students will need in future lessons, such as the sexual propagation of plants. The PowerPoint presentations will serve as an introductory guide for students to acquire knowledge regarding the parts of the flower as well as the terminology they will need. Students will envelop a concept map detailing flower anatomy, a dichotomous key detailing flower structures, and a display to compare and contrast flower types.

Pollination and fertilization are introduced in this lesson. To avoid students developing misconceptions, check for student understanding since future lessons build upon this foundational knowledge.

Learning Targets
1. The parts of the flower are the mechanisms for pollination and fertilization and are used by a plant to complete sexual reproduction.
2. Concept maps assist in structuring ideas or concepts and illustrating the various connections between those ideas.

3. Flowers are classified as either complete or incomplete based on the inclusion of either male or female parts or both.
4. Flowering structures are precursors for seeds, seed pods, fruit.

Formative Assessment

1. Identify the parts of a flower and explain the function fro each part. (Activity 4.5.1)
2. Develop a concept map to illustrate the understanding of related ideas and nomenclature necessary to discuss the parts and functions of a flower. (Activity 4.5.2)
3. Classify flowers using a dichotomous key and predict the type of pollination for each flower. (Activity 4.5.3)
4. Use knowledge of flower structure to predict the type of seed structure based on a flowering structure. (Project 4.5.4)

Unit: Taxonomy

Duration: 6 Day(s)

Unit Description

Students learn and practice how to identify, classify, sort and name plants.

Academic Vocabulary

Annuals
Biennial
Binomial system
Botanical name
Cereal
Class
Classification
Conifer
Cultivar
Deciduous
Dicotyledon
Division
Family
Forage
Genus
Hierarchy
Kingdom
Latin
Legume
Lifecycle
Monocotyledon
Morphology
Nomenclature
Order
Perennial
Prefix
Species
Suffix
Taxonomist
Taxonomy
Variety

Topic: Sorting Out Plants

Duration: 6 Day(s)

Topic Description (short)

This lesson introduces students to classification and nomenclature systems. The activities help students understand the conceptual basis of classification and the formal process of naming and identifying plant species. Students examine the role of the genus and species name in plant nomenclature and conclude the lesson by creating a plant species.

Learning Targets

1. Plants are organized and identified and using physical characteristics.
2. Plants and animals are categorized using a hierarchical system to group organisms by anatomical or physiological similarities.
3. The scientific names for plants consist of Latin words representing descriptive features associated with the plant.
4. All plants are named using a binomial system, which is a two-word system for naming plants with the first word being the generic name and the second word being the specific name.
5. Plant species are often subdivided into varieties and cultivars that will include additional names after the genus and species.

Formative Assessment

1. Develop a flowchart to classify 20 different species of plants. (Activity 5.1.1)
2. Research the taxonomic classification for a plant species. (Activity 5.1.2)
3. Research the meaning of scientific names for ten species of trees. (Activity 5.1.3)
4. Create a fictitious plant describing the physical features and apply the principles of binomial nomenclature to create a common and

scientific name for the plant. (Project 5.1.4)
5. Create a cultivar name for a fictitious plant. (Project 5.1.4)

Unit: The Growing Environment

Duration: 26 Day(s)

Unit Description

During this unit, students explore plant growth requirements. They begin measuring soil fertility and calculating nutrient needs. Then students move on to observing the effects of moisture, light, and temperature on plant growth and development.

Topic: Plant Food

Duration: 6 Day(s)

Topic Description (short)

In this lesson, students will research fertilizer options and calculate fertilizer application rates. Nutrient deficiency identification and fertilizer calculations are essential for growing plants successfully. Students will also examine a chart of nutrient interactions in the soil and interpret in the soil and interpret a soil analysis report.

Learning Targets

1. Plants obtain required nutrients from the soil provided the soil has the available nutrients.
2. Nutrient deficiencies are detected in plants by the examination of anatomical features and chemical tissue tests.
3. Nutrients can be added to the soil in various forms, such as chemical fertilizers, animal wastes and organic matter.
4. Plants require sixteen nutrients for optimal growth and development.

Formative Assessment

1. Use testing equipment to detect the levels of nitrogen, phosphorus, and potassium in soil samples. (Activity 6.1.1)
2. Identify the effects of nutrient deficiencies in plants by observing anatomical differences. (Activity 6.1.2)
Conduct plant tissue testing to determine the potential nutrients that are lacking in growing plants. (Activity 6.1.2)
3. Use mathematical formulas to solve problems regarding fertilizer analyses, rates, and cost comparisons. (Activity 6.1.3)
4. Define soil nutrient relationship using Mulder's Chart. (Activity 6.1.4)
5. Read a sample soil analysis and compare it to crop nutrient removal rates. (Activity 6.1.4)

Topic: All Wet

Duration: 6 Day(s)

Topic Description (short)

Water is supplied too the plant naturally by rainfall or artificially by irrigation. Besides transpiration, other water losses include evaporation and runoff, which are addressed in this lesson. This lesson will provide students with practical connections associated with water management for other plant activities.

Learning Targets

1. The composition of plant containers will affect the rate of water loss by evaporation in potted plants.
2. Water is used by plants for the translocation of materials within the vascular systems of plants and used to complete the photosynthesis process.
3. Water is used to help cool the plant during periods of above optimal temperature conditions through the process of transpiration.
4. Water requirements and tolerances vary among plant species.
5. The wilting point is a critical physiological stage that, if exceeded, can cause permanent damage to the health and physical appearance of plants.

Formative Assessment

1. Conduct an experiment to determine the rate of transpiration and evaporation for different plant growing containers.
2. Collect evidence of water movement through a stem detecting transpiration pull.
3. Examine how environmental conditions affect the water loss of a plant.
4. Compare wilting points among various species.
5. Monitor soil moisture to determine the wilting point of different plant species.

Topic: Lighting It Up

Duration: 7 Day(s)

Topic Description (short)

Students will take a closer look at light in terms of spectrum and intensity. They will learn how plants respond to different portions of the light spectrum and how physical deformities can result for variations in light quality and intensity. The lesson concludes with an opportunity to schedule plants for markets by learning how to program plants using alterations to light exposure.

Learning Targets

1. Light is absorbed by chlorophyll and used by plants to convert carbon dioxide and water into glucose and oxygen through the process of photosynthesis.
2. Light intensity and poor light exposure can alter the growth of plants by creating undesirable physical characteristics.
3. Photosynthetic rate is affected by environmental factors, such as light exposure, availability of carbon dioxide and temperature.
4. The level of red and blue-violet light emitted in a spectrum determines the quality of a light sources intended for plant use.
5. Plants respond to the length of daily dark periods to trigger physiological processes, such as flowering.

Formative Assessment
1. Collect evidence of dependence of photosynthesis with light.
2. Conduct an investigation to determine the effects of light intensity on plant growth.
3. Manipulate environmental factors to test their effects on plants.
4. Examine the relationship between the rate of photosynthesis and light spectrum quality.
5. Calculate target dates for marketing flowering plants based on the length of time that plants are exposed to light.

Topic: Chilly Lilies **Duration:** 7 Day(s)

Topic Description (short)
This lesson examines how plants respond to temperature and how producers can use temperature to schedule plants for marketing purposes. An activity, a project, and a problem are each designed to provide instruction related to growing degree days and vernalization.

Learning Targets
1. Plant maturity is affected by the accumulation of thermal units during a growing season.
2. Temperature affects the metabolism rate of plants,, including transpiration, respiration and photosynthesis.
3. Temperature is a principle determinant for plant dormancy of some seeds, bulbs, specialized roots, and species of perennial plants.
4. Plants are classified as cool-season or warm-season plants based on their temperature requirements.

Formative Assessment
1. Calculate estimated plant maturity dates using growing degree-days to compare two geographical locations.
2. Calculate growing schedule for a crop started on the same date with three different maturity target dates.
3. Plant bulbs and schedule flowering for those bulbs to meet a holiday delivery date.
4. Explore hardiness zones and assign plants to appropriate zones according to temperature requirements.

Unit: Sexual Reproduction **Duration:** 28 Day(s)

Unit Description
Students explore the methods and science of sexual and asexual plant reproduction. They begin the unit observing the process of cell replication and the passing of genetic traits. Next, they discover how plants produce seeds and the physiological process of germination. Students complete the unit by practicing asexual methods, such as layering and cuttings used for reproduction.

Topic: Plant Genetics **Duration:** 6 Day(s)

Topic Description (short)
Students use simulation software, Mendelian genetics to predict plant offspring. Students will breed parents with different genotypes to simulate the production of offspring. Students will test their predictions to understand the role genetics plays in plant production. Crossbreeding to produce hardier, more productive hybrid plants is the next step.

Learning Targets
1. Plant egg cells require meiosis and mitosis for development.
2. Fertilization, a necessary step for seed development, occurs when pollen unites with an egg cell.
3. Dominant and recessive alleles determine the phenotypic characteristics of plants.
4. Hybrid plants are an important source of agronomic commodities.

Formative Assessment
1. Describe the steps of gamete cell production.
2. Illustrate the processes of meiosis and fertilization of an egg.
3. Perform computer simulations related to genetic inheritance to learn about the role genetics play in plant production.
4. Perform a simulation predicting offspring from a hyrbrid cross.

Topic: Pollination & Dispersion **Duration:** 7 Day(s)

Topic Description (short)
During this lesson, students explore the codependency among plants, animals their environment. Students identify pollination agents, calculate biotic potential, and develop dichotomous keys to classify seed bearing structures.

Learning Targets
1. Flower pollination often requires natural agents, such as wind, water, insects, and vertebrates.
2. Plants use seeds to multiply species exponentially over time.
3. Identification and classification of plant species often rely on special structures that protect and support seeds.
4. Plants require methods of seed dispersal to ensure their survival in nature.

Formative Assessment
1. Use clues given to identify the type of pollination agent in a variety of scenarios.
2. Calculate the reproductive biotic potential of plants.
3. Develop a dichotomous key to classify seed-bearing structures.
4. Analyze articles related to issues involving seed dispersal to develop prescriptive plans to resolve the issue of seed dispersal.

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