			Greenhouse Management Grades 11-12 **Unit #1**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Horticulture Industry**	**Suggested Timeline:** **1 Week**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local businesses for authentic and relevant educational experiences.
Grade Level Units	**Unit 1: The Greenhouse Industry Introduction (1 week)** Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	The Horticulture Industry
Unit Summary	This unit of instruction will address various facets of horticulture and careers, safety concerns of the industry, and experiential learning opportunities within the FFA organization.

Unit Essential Questions: 1. What are the botanical sciences and related careers and jobs? 2. What are the best practices to keep a horticulture worker safe? 3. What experiential learning benefits does FFA Supervised Agricultural provide?	**Key Understandings:** 1. Employment opportunities in horticulture are extremely diverse among personal and educational requirements, income, and skill sets. 2. Adopting a culture of safety is critical to maintain health and job productivity. 3. SAE should document technical skill attainment, academic learning and other key concepts in addition to financial success.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
CRP.03	Attend to personal health and well-being.
CRP.10.01.01.c.	Plan a career path based on personal interests, goals, talents and preferences.
CRP.10.02.01.a.	Categorize career advancement requirements for potential careers (e.g., degrees, certification, training, etc.).

Important Standards Addressed in the Unit:	

Misconceptions:	**Proper Conceptions:**
1. Employment in food systems requires little scientific knowledge. 2. There are few hazards in the food system. 3. FFA SAE only benefits farmers.	1. Food systems employs unskilled to highly skilled workers, with no education to doctoral degrees. 2. Workplace hazards are common, especially since most workers work independently.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Plant science disciplines ● Related careers ● Occupational safety ● SAE project operation and student benefit	● Differentiate between the sciences and the impact on the food and fiber systems. ● Investigate emerging technologies within practical applications of plant science. ● Recognize and demonstrate safety rules and regulations. ● Demonstrate positive safety attitudes and responsibilities. ● Select and demonstrate the safe use of appropriate tools for the maintenance of mechanical systems. ● Locate and comprehend Safety Data Sheets (SDS) (formerly MSDS). ● Maintain accurate program plans and records (i.e. SAE) ● Research career opportunities in horticulture. ● Create a plan to achieve career goals and priorities.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:		
● botanist ● bramble ● enologist ● ethylene ● evapotranspiration ● forest stand geocarpy ● green industry	● cavore ● nursery ● olericulture ● organic food ● ornamental horticulture ● perennial ● plant science	● postharvest ● propagate ● senescence ● silviculture ● sod ● viticulturist

● hardscape ● horticulturist ● interiorscaping	● pomology,	

Assessments:

- Career Plan Timeline
- Safety Skills Assessment
- SAE Establishment

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #2**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Greenhouse Design, Construction, Components**	**Suggested Timeline:** **2 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local businesses for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) **Unit 2: Greenhouse Design, Construction, Components (2 weeks)** Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Greenhouse Design, Construction, Components**
Unit Summary	In this unit, students will learn criteria for greenhouse industry success, structure designs and materials, and system operation, maintenance and upkeep requirements.

Unit Essential Questions: 1. What makes a greenhouse industry successful? 2. How are the materials applied in various greenhouse designs? 3. How are controlled environment plant growth systems operated and maintained?	**Key Understandings:** 1. Greenhouse industry success depends on physical location, market potential, utilities available, climate, and production goals. 2. Greenhouse industries select frames, coverings, and glazing materials based on cost effectiveness, stability, maintenance, and function. 3. Routine and preventative maintenance, monitoring, and troubleshooting to facilities and equipment is critical to longevity and productivity of greenhouse systems.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
PS.03.02.06.a.	Identify and categorize structures and technologies used for controlled atmosphere production of plants.
PS.03.02.06.b.	Compare and contrast the types of technologies used for controlled atmosphere production.
PS.03.02.06.c.	Research, select and defend technology for use in controlled atmosphere production.

Important Standards Addressed in the Unit:

Misconceptions:	**Proper Conceptions:**
1. Greenhouse work is just about growing plants. 2. Systems require little maintenance.	1. Greenhouse industry utilizes people with basic mechanical skills such as wiring, plumbing, and general construction. 2. Systems of environmental control must be routinely observed and maintained for proper function.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Greenhouse planning factors ● Greenhouse structures ● Greenhouse systems components ● Careers in greenhouse operations and maintenance	● Describe factors in planning a greenhouse. ● List, describe, and identify greenhouse structures. ● Demonstrate safe greenhouse system operation and maintenance.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

● aspirated thermostat, ● cold frame ● cool cell ● eave ● emitter ● fogger ● gable ● glazing ● greenhouse orientation ● greenhouse range	● high tunnel ● horizontal air fan (HAF) ● hotbed ● louver ● manometer ● perforated convection tube ● photocell ● ridge	● shutter ● static pressure ● sump pump ● sump tank ● thermostat ● topography ● vent

Assessments:

- Identify greenhouse designs, materials, and systems.
- Design and build an annotated greenhouse model.
- Demonstrate routine maintenance of various greenhouse systems.

- Site visit to local greenhouse for comparative analysis activity.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #3**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Growing Media**	**Suggested Timeline:** **2 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) **Unit 3: Growing Media (2 weeks)** Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Growing Media (2 weeks)**
Unit Summary	In this unit students will be exposed to applications of soil and soilless media in plant production systems. They will investigate media physical and chemical properties, as well as cost effectiveness, and be able to justify media selections for various plant production systems.

Unit Essential Questions: 1. How do the soil characteristics impact plant growth? 2. What are the effects of soilless media components on plant growth? 3. How do plant producers manipulate media in controlled environment systems?	**Key Understandings:** 1. Soil structure, color, texture, and pH impact plant growth. 2. Controlled environment agriculture mimics nature for the purpose of more predictable, reliable, and consistent results. 3. Media knowledge and skills are critical to successful greenhouse industry employment.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
PS.03.02.02.a.	List and summarize the reasons for preparing growing media before planting.
PS.03.02.02.b.	Prepare soil and growing media for planting with the addition of amendments.
PS.03.02.02.c.	Analyze how mechanical planting equipment performs soil preparation and seed placement.

Important Standards Addressed in the Unit:

Misconceptions:	**Proper Conceptions:**
1. All plants grow in dirt. 2. All plants grow equally well in all media.	1. Various plants require various media for optimum production. 2. Humans can manipulate media to maximize plant production.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Growing media: attributes and effects ● Media preparation methods ● Record Keeping ● Occupational Safety	● Identify growing media ● Comparing and contrasting media in plant growing systems ● Sample and test soils ● Calculate media mixes ● Compare cost effectiveness of various media	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

● adhesion	● crop	● plasticulture
● adsorbed	● desorbed	● porosity
● aeration	● electrical conductivity meter (EC)	● pyrolysis
● A horizon	● field capacity	● relief
● anion	● geotextile	● respire
● bark	● gravitational water	● rhizobia
● B horizon	● green waste	● sandy soil
● biochar	● horizon	● saturation
● bioplastic	● hydrometer	● slow-release fertilizer
● brown waste	● infiltration	● soil auger
● bulk density	● ion	● soilless media
● capillary water	● loamy soil	● soil pH
● cation exchange capacity (CEC)	● macropore	● soil pore space
● chlorosis	● micropore	● soil probe
● C horizon	● mulching	● soil structure
● clayey soil	● mulch mat	● soil survey
● coconut coir	● mycorrhiza	● soil texture

● cohesion ● compost ● cover	● organic matter ● parent material ● pedologist ● pedology ● peds ● perlite ● pH paper	● surface horizon ● topsoil ● vermiculite ● weathering

Assessments:

- Vocabulary assessment
- Written essay comparing and contrasting media in plant growing systems
- Media component identification
- Sample and test soils

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #5**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Plant Nutrition**	**Suggested Timeline:** **2 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) **Unit 5: Plant Nutrition (2 weeks)** Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Plant Nutrition (2 weeks)**
Unit Summary	This unit will cover the importance of the seventeen essential plant nutrients for plant health, and how humans manipulate the application for optimum plant production. Fertilizer identification, formulations, ratio calculations, and label interpretation will be addressed.

Unit Essential Questions:	**Key Understandings:**
1. How do nutrients influence plant growth? 2. How do humans manipulate nutrients in the horticulture industry?	1. There are seventeen essential nutrients that influence plant health. 2. Humans manipulate nutrient applications depending on desired plant product through timing, amount, and formulations.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved

PS.01.03.	PS.01.03. Develop and implement a fertilization plan for specific plants or crops.
PS.01.03.01.a.	Identify the essential nutrients for plant growth and development and their major functions (e.g., nitrogen, phosphorous, potassium, etc.).
PS.01.03.01.b.	Analyze the effect of nutrient deficiencies and symptoms and recognize environmental causes of nutrient deficiencies.
PS.01.03.01.c.	Monitor plants for signs of nutrient deficiencies and prepare a scouting report to correct elements negatively affecting plant growth in a field or greenhouse.

Important Standards Addressed in the Unit:	

Misconceptions:	**Proper Conceptions:**
1. Plants grow independent of human inputs. 2. There is do difference between nutrients and the plant processes they affect. 3. Plant labels are only for professional growers.	1. Macro and micronutrients are required and can be manipulated by greenhouse workers. 2. Different nutrients control various plant processes. 3. Misapplication of fertilizer can have safety and economic impacts.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Elements used by plants ● Pathway of mineral nutrient uptake ● Fertilizer: sources, application, pathway ● Record Keeping ● Occupational Safety ● Careers	● Recognize elements used by plants, and associated processes. ● Recognize nutrient deficiencies in plants. ● Read and analyze a fertilizer label. ● Calculate proper formulations based on label directions. ● Demonstrate through a presentation or live setting, the ability to follow fertilizer label procedures as they pertain to selection, handling, application, storage, and disposal.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

● Ammonification ● assimilation ● banding ● broadcasting ● chelate ● complete fertilizer ● cytochrome	● denitrification ● fertigation ● fertilizer gradae ● foliar application ● interveinal area ● macronutrient ● micronutrient,	● necrotic lesion ● nitrification ● phytoremediation ● phytotoxicity ● ratio ● side-dressing ● soluble

● deficiency		● sorption ● superphosphate ● tilth

Assessments:

- Distinguish among nutrient deficiencies and toxicities in plant images and specimens.
- Research case studies, then justify in an informative essay use of different fertilizer precautions.
- Fertilizer and equipment application identification quiz.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #6**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Plant Propagation**	**Suggested Timeline:** **3 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) **Unit 6: Plant Propagation (2 weeks)** Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Plant Propagation (3 Weeks)**
Unit Summary	In this unit, plant reproduction will be studied by conducting sexual and asexual propagation labs. Students will compare and contrast cuttings, budding, layering, division, sowing, and micropropagation. Seed viability and seed germination requirements will be applied in greenhouse production.

Unit Essential Questions:	**Key Understandings:**
1. How do plants reproduce? 2. What are the factors of seed germination? 3. What seed propagation techniques are used in the greenhouse industry? 4. What are the biological principles of leaf and stem propagation? 5. What plant materials are used in propagation? 6. What factors influence plant propagation? 7. What are careers in plant propagation?	1. Plants reproduce sexually and asexually, which humans mimic for needs of society. 2. Various environmental factors affect seed germination, and all can be controlled in agricultural operations. 3. Field seeding, nurseries, and greenhouses all use common knowledge of seeding techniques. 4. Plants can be propagated via leaves and stems through preformed roots, wounds, and environmental conditions, layering, division, grafting and budding, and tissue culture. 5. Hardwood, semihardwood, softwood, herbaceous materials, leaves, leaf-buds, and roots are used in plant propagation.

	6. Media, growth regulators, and environmental conditions affect plant propagation success. 7. Many careers related to propagation are essential to sustainable ornamental and edible horticulture.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
PS.03.01	Propagate, culture and harvest plants and plant products based on current industry standards.
PS.03.04.	Apply principles and practices of sustainable agriculture to plant production.

Important Standards Addressed in the Unit:	

Misconceptions:	**Proper Conceptions:**
1. All seeds sprout by the same method. 2. Environmental conditional conditions cannot be controlled for seed sprouting. 3. Humans cannot influence asexual plant reproduction. 4. Asexual reproduction can only be done in a laboratory. 5. Plant cloning always uses genetically modified organisms.	1. Plant genera have various germination requirements. 2. Humans manipulate conditions for seed production. 3. Human can reproduce plants from plant parts or plant cells. 4. Asexual reproduction occurs with and without human intervention. 5. Plant cloning and GMO's are two unrelated concepts.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Seed Germination: morphology, seed development, environmental requirements ● Asexual propagation: concepts, methods, advantages and disadvantages ● Grafting and budding- benefits and methods ● Micropropagation: history, future applications ● Record Keeping ● Occupational Safety ● Careers	● Summarize valid research in the areas of plant propagation. ● Germinate seeds and calculate seed viability. ● Asexually propagate plants $\geq$ 85% success. ● Sow seeds $\geq$ 85% success. ● Participate in a tissue culture field trip. ● Identify potential hazards and practice workplace safety in the greenhouse lab.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary: ,

- Abscisic acid
- cell expansion
- desiccation
- genetically modified organism
- germplasm
- imbibition
- lag phase
- photodormancy
- plug
- plumule
- priming
- quiescent
- radicle
- scarification
- seedbed
- seedlot
- thermodormancy
- transgenic
- viable
- vivipary
- abscise
- acclimatization
- auxin
- callus tissue
- cytokinins, differentiate
- distal
- hardwood
- herbaceious
- leaf-bud cutting
- phytohormone
- plantlet
- polarity
- proximal
- softwood
- stock plant
- suberin
- vegetative propagation
- air layering
- bulblet
- cormel
- girdlin
- layering
- mound layering
- rhizome
- stolon
- separation
- sucker
- tubercle
- tunicate
- bench grafting
- bridge grafting
- budding
- budwood
- cleft grafting
- grafting
- interstock
- scion
- splice grafting
- wedge grafting
- whip-and tongue grafting

Assessments:

- Compare and contrast the different techniques of plant propagation in an informative text.
- Cite advantages and disadvantages of sexual and asexual propagation.
- Plant propagation vocabulary quiz.
- Students conduct plant propagation labs and submit lab report.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #7**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Greenhouse Production**	**Suggested Timeline:** **2 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) **Unit 7: Environmental Control Systems (2 weeks)** Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Environmental Control Systems (2 weeks)**
Unit Summary	This unit addresses the fundamental concepts for a greenhouse grower's success: crop selection and scheduling, specific growing conditions, plant health, and industry inputs and variables.

Unit Essential Questions:	**Key Understandings:**
1. How do greenhouse systems meet requirements for plants grown in controlled environments? 2. What are crop inputs for greenhouse grown crops? 3. Describe types of greenhouse crops and the various plant materials used in production.	1. A grower dictates every decision in greenhouse production, maintenance, and business success. 2. Each plant requires unique growing environment. 3. Critical thinking skills, plant knowledge, and adjustments must be made with each different growing season.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
PS.03.02.04.a.	Observe and record environmental conditions during the germination, growth and development of a crop.
PS.03.02.04.b.	Monitor the progress of plantings and determine the need to adjust environmental conditions.
PS.03.02.04.c.	Prepare and implement a plant production schedule based on predicted environmental conditions and desired market target (e.g., having plants
PS.03.02.04.c.	Analyze and describe plant responses to light color, intensity and duration (organic production, low maintenance landscape plants, etc.).
PS.01.01.02.b.	Determine the optimal air and temperature conditions for plant growth.
PS.01.01.03.b	Analyze and describe plant water conditions.

Important Standards Addressed in the Unit:	

Misconceptions:	**Proper Conceptions:**
1. All plants in a greenhouse will live. 2. Growers make profits year-round. 3. There are some environmental factors in a greenhouse that cannot be controlled.	1. Plants will die quicker in a greenhouse than outside. 2. Crop production decisions are often made to cut losses. 3. All plant production factors can be managed.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Plant requirements and systems: light, air, nutrients, temperature ● Crop Inputs: media, plant growth regulators, containers, trays, tags, and labels ● Plant Materials: seeds, unrooted cuttings, plugs, liners, bare root, bulbs and tubers ● Greenhouse Crop Types: containers, foliage, vegetables and herbs, cut flowers, bedding plants, perennials ● Record Keeping ● Occupational Safety ● Careers	● Assess the environmental factors that affect the growth and development of a plant. ● Investigate the emerging technologies within practical applications of plant science. ● Produce a variety of greenhouse crops. ● Identify plant materials, greenhouse crops. ● Identify and properly apply crop inputs to various crops. ● Identify potential hazards and practice workplace safety in the greenhouse lab. ● Keep an accurate account of lab activities	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

- bedding plant
- bio-stimulant
- container capacity
- critical day length (CDL)
- critical night interval (CNI)
- cyclic photoperiod lighting
- evergreen
- flaggin
- incomplete fertilizer
- insoluble fertilizer
- liner
- night interruption (NI)
- plant growth regulator (PGR)

Assessments:

- Crop Production Plan Project
- Site Evaluation and Research Recommendation
- Identification quiz of greenhouse tools, systems, materials, and supplies.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #8**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Diseases, Disorders, and Pests**	**Suggested Timeline:** **2 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) **Unit 8: Diseases, Disorders, and Pests (2 weeks)** Unit 9: Hydroponic Applications (2 weeks) Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Diseases, Disorders, and Pests (2 weeks)**
Unit Summary	This unit will address greenhouse plant diseases, disorders, and pests in terms of economic and aesthetic impact, identification, diagnosis, and control. This includes integrated pest management evaluations as well as pesticide label interpretation and applications.

Unit Essential Questions: 1. How do plant diseases, disorders, and pests affect the greenhouse industry? 2. How are diseases, disorders, and pests managed? 3. How are pesticides safely managed?	**Key Understandings:** 1. Host-specific diseases, disorders, and pests cause economic and aesthetic impacts. 2. Integrated Pest Management uses numerous control measures, inspections, monitoring, action thresholds, and corrective actions to achieve plant health. 3. Safe pesticide use includes knowledge of pesticide types, formulations, labels, applications, certification requirements, toxicity, and proper storage and disposal.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
PS.01.	Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
PS.02.	Apply principals of classification, plant anatomy, and plant physiology to plant production and management.
PS.03.	Propagate, culture, and harvest plant and plant products based on current industry standards.

Important Standards Addressed in the Unit:	

Misconceptions:	**Proper Conceptions:**
1. A greenhouse protects plants from pests. 2. Spraying is the easiest form of pest control. 3. All pests can be controlled the same way.	1. A greenhouse creates an ideal microclimate for pest problems. 2. Spraying should be used as a last resort when controlling greenhouse pests. 3. Host- specific diseases, disorders, and pests have various control methods.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Integrated Pest Management ● Identification and management of insects, disease, weeds, disorders ● Pesticide Management and Safety ● Careers ● Occupational Safety ● Record Keeping	● Determine economic and aesthetic impact of plant diseases, disorders, and pests. ● Identify and diagnose diseases, disorders, and pests and summarize methods of prevention, treatment, and control by drawing on evidence form informational texts and industry resources. ● Identify the types of pesticides, their safety hazards, and calculate applications for greenhouse production. ● Demonstrate the ability to follow pesticide procedures, including application records, according to label and safety guidelines. ● Know resources for and apply steps of IPM for greenhouse crops. ● Identify potential hazards and practice workplace safety in the greenhouse lab.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

- Action threshold
- anti-transpirant
- beneficial
- economic injury level
- integrated pest management
- oomycete
- pest
- pesticide
- pheromone
- plant pathogen
- scouting
- vector
- allomone
- pheromone
- complete metamorphosis
- embryogenesis
- entomology
- incomplete metamorphosis
- instar
- parthenogenesis
- proboscis
- stylet
- vivipar
- abiotic
- biotic
- disease triangle
- fungus
- gall
- host
- inoculum
- parasitic plant
- pathogen
- sign
- symptom
- toxicity
- virus
- contact herbicide
- nonselective herbicide,
- post-emergent herbicide
- pre-emergent herbicide
- selective herbicide
- solarization
- systemic herbicide
- tillering
- broadleaf weed
- active ingredient
- acute toxicity
- chronic toxicity
- EPA registration number
- personal protective equipment
- LC50
- LD50
- pesticide formulation
- restricted entry interval
- signal word

Assessments:

- Disease, disorder, pest identification and control identification assessments
- Student chemical label interpretation, formulation, and handling demonstrations
- Greenhouse Crop IPM Project

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:

- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:

- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds

- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #9**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**21st Century Horticulture**	**Suggested Timeline:** **2 Weeks**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) **Unit 9: Hydroponic Applications (2 weeks)** Unit 10: Greenhouse Business Management (1 week)

Unit Title	**Twenty-First Century Horticulture (2 week)**
Unit Summary	The unit will examine emerging technologies in twenty-first century horticulture including hydroponics, aquaponics, aquaculture, rooftop gardening, vertical gardening, raised bed gardening, and local food systems.

Unit Essential Questions: 1. How do various water systems work for plant and/or animal production? 2. What are the applications, advantages, and/or disadvantages of water culture? 3. What are benefits and applications of vertical gardening, raised beds, and rooftop gardens, and other trends in horticulture?	**Key Understandings:** 1. Humans mimic natural systems for food production needs. 2. Water-based plant systems have the benefits of being a closed loop system, not requiring land, large equipment, and other inputs for conventional food production methods; often provides ADA accommodations and other horticulture therapy applications.

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved.
PS.03.04.	Apply principles and practices of sustainable agriculture to plant production.
PS.04.	Apply principles of design in plant systems to enhance an environment.

Important Standards Addressed in the Unit:

Misconceptions:	**Proper Conceptions:**
1. There are only a few systems by which to grow plants. 2. Plant growth is technical and can only be done by scientists. 3. Food systems have little importance in a personal and economic health.	1. There are several growing systems for plant growth. 2. Plant systems are developed as a result of personal and societal needs, irrespective of academic abilities. 3. Purchasing local foods benefit personal health and local economies.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Design, components, and environmental impacts of nontraditional gardening systems, including water culture, rooftops, and vertical gardens ● Record ● Keeping ● Occupational Safety ● Careers	● Explain components and mechanics of various hydroponic systems. ● Describe aquaponic systems. ● Explain plant and animal processes that allow successful aquaculture systems for food production. ● Design a vertical and rooftop gardens. ● Understand food aggregation and distribution systems in the United States. ● Identify potential hazards and practice workplace safety in the greenhouse lab.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

● eroponic system ● aggregate ● aquaponics ● biofilm ● biopharming ● culling ● deep water culture ● drip system	● ebb and flow system ● effluent ● extensive green roof system ● ground level ozone ● heat island effect ● hydroponics ● intensive green roof system	● lasagna composting ● nutrient film technique (NFT) ● square foot gardening ● vertical gardening ● water culture system

Assessments:

- Identification of materials, components, and functions of water culture systems.

- Team design and build of a water culture system, vertical garden, or raised beds for plant and/or animal production.
- Create a brochure and marketing materials for campus-grown produce.

Suggested Strategies to Support Design of Coherent Instruction

Charlotte Danielson's Framework for Teaching: Domain 3 Instruction

3a Communicating with Students

3b Using Questioning and Discussion Techniques

3c Engaging Students in Learning

3d Using Assessment in Instruction

3e Demonstrating Flexibility and Responsiveness

Interdisciplinary Connections:
- Language Arts, Reading and Writing, Speaking, Math

Additional Resources:
- Horticulture Today, Riedel and Driscoll, 2017, Internet access, SmartBoard, horticulture learning lab and growing fields, fruit and vegetable seeds
- Pathways Through Horticulture, Pennsylvania Landscape and Nurseryman's Association

Created By:

Carol Richwine

			Greenhouse Management Grades 11-12 **Unit #10**
Course/Subject: Greenhouse Management	**Grade:** 11-12	**Greenhouse Business Management**	**Suggested Timeline:** **1 Week**

Grade Level Summary	Greenhouse management is an applied- knowledge course designed to prepare students for employment in the greenhouse industry. This course covers principles of greenhouse structures, plant health and growth, growing media, greenhouse crop selection and propagation, and management techniques. Upon completion of this course, proficient students will be equipped with the technical knowledge and skills needed to prepare for further education and careers in horticulture production. Pennsylvania is ranked 9th nationally in floriculture crops, and NYCSD is fortunate to partner with local industries for authentic and relevant educational experiences.
Grade Level Units	Unit 1: The Greenhouse Industry Introduction (1 week) Unit 2: Greenhouse Design, Construction, Components (2 weeks) Unit 3: Growing Media (2 weeks) Unit 4: Plant Structure, Function, and Growth (2 weeks) Unit 5: Plant Nutrition (2 weeks) Unit 6: Plant Propagation (2 weeks) Unit 7: Environmental Control Systems (2 weeks) Unit 8: Diseases, Disorders, and Pests (2 weeks) Unit 9: Hydroponic Applications (2 weeks) **Unit 10: Greenhouse Business Management (1 week)**

Unit Title	**Greenhouse Business Management (1 week)**
Unit Summary	This unit presents various business structures and strategies for successful horticulture operations. It also provides information for students to secure and maintain employment in horticultural industries.

Unit Essential Questions: 1. What business structures are most successful for horticulture industries? 2. What are the guiding operations used in running horticulture businesses? 3. What professional skills are needed to secure and keep a job in the green industry?	**Key Understandings:** 1. Primary business structures include entrepreuners, partnerships, cooperatives, and limited liability corporations. 2. Mission, vision, and marketing greatly affect business success. 3. Written and spoken language skills vary among positions, but are critical to job security and advancement.

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
CRP.02.02.01.c.	Apply technical concepts to solve problems in the workplace and react upon the results achieved
ABS.01.02.01.a.	Read and interpret statements of purpose (e.g., vision, mission statement, charter, etc.).
ABS.04.01.02.a.	Categorize the characteristics of the types of ownership structures used in AFNR businesses (e.g., sole proprietorships, cooperatives, partnerships and corporations).
ABS.05.03.01.a.	Identify and explain market- ing principles used in AFNR businesses (e.g., - tion, interest, desire, action, etc.).

Important Standards Addressed in the Unit:

Misconceptions:	**Proper Conceptions:**
Plants sell themselves. Customers buying habits cannot be influenced. There is one owner for each business.	1. Proper marketing and business decision determine product sales. 2.Customers purchasing pattern can be strongly influenced by marketing. 3. Various business structures can be applied to various horticulture operations.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Strategic business plan purpose and parts ● Marketing and advertising in horticulture businesses ● Written and spoken professionalism in horticultural employees ● Careers	● Identify factors of successful small businesses in horticulture. ● Identify successful marketing and advertising strategies for a small horticulture business. ● Exhibit written, spoken, and workplace professional documents, traits, and behavior for successful employment in the green industry.	● Precision and Accuracy ● Critical Thinking/Problem Solving

Academic Vocabulary:

● branding ● direct sales ● reseller sales ● entrepreneur ● small business ● strategic business plan ● vision ● mission statement	● core ideology ● envisioned future ● profit margin ● marketing ● advertising ● intensive and selective	● market coverage ● professionalism ● letter of application ● resume’

Assessments:

- Vocabulary assessment
- Creation of a mock company with mission statement, vision statement, brand, and advertising material
- Resume and letter of application

Suggested Strategies to Support Design of Coherent Instruction

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Interdisciplinary Connections:

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Additional Resources:

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