



Greenhouse Management

Course: Ornamental Horticulture		Total Framework Hours: 62 hours
CIP Code: 010603	☒ Exploratory ☐ Preparatory	Date Last Modified: April 1, 2021
Career Cluster: Agriculture, Food and Natural Resources		Cluster Pathway: Plant Systems

To duplicate this blank table (for additional units), select the table, select copy, place cursor below the first table, and select paste.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

1. Compare and contrast tools used in the horticulture industry.
2. **Safety Tests** – take and pass all horticulture tool safety tests with 100%.
3. Practice safe use of horticulture tools in both indoor and outdoor settings.
4. Examine proper care and production methods for greenhouse plants and create a beneficial environment.

Leadership Alignment:

21st Century Skills

- 2.A.1. Use various types of reasoning as appropriate to the situation – Safety Tests

Standards and Competencies

Unit 1: Greenhouse Safety

Industry Standards and/or Competencies

Total Learning Hours for Unit: 5

Greenhouse Management Precision Exams – Knowledge Standards

Standard 3 – STUDENTS WILL DEMONSTRATE GREENHOUSE CROP PRODUCTION TECHNIQUES.

- Objective 2: Explain greenhouse climate control.

AFNR – Plant Systems Standards

• PS.03.02. Develop and implement a management plan for plant production.

- PS.03.02.04.b. Monitor the progress of plantings and determine the need to adjust environmental conditions.

Aligned Washington State Learning Standards

Arts	
Computer Science	
Educational Technology	
English Language Arts	
Environment & Sustainability	
Financial Education	

Health and Physical Education	H1.Sa1.HS Describe how to prevent occupational injuries.
Mathematics	
Science	
Social Studies	
COMPONENTS AND ASSESSMENTS	
Performance Assessments: 1. Examine the effect of light on greenhouse crops and describe the influence of temperature on greenhouse crops. 2. Describe the process of seed germination and demonstrate techniques for sowing seeds. 3. Seed Germination Calculation – determination the amount of plants required for annual plant sale and calculate the germination rate. 4. Demonstrate techniques used to propagate plants by cuttings, division, separation, and layering. 5. Identify proper timing and transplant greenhouse plant materials using proper techniques.	
Leadership Alignment: <u>21st Century Skills</u> 10.B.1.b. Manage time and projects effectively. – Seed Germination and Transplanting Plant Materials FFA Floriculture CDE – practice Plant Growing Procedures practicum using standards.	
Standards and Competencies	
Unit 2: Greenhouse Plant Propagation	
Industry Standards and/or Competencies	Total Learning Hours for Unit: 11
Greenhouse Management Precision Exams – Knowledge Standards Standard 3 – STUDENTS WILL DEMONSTRATE GREENHOUSE CROP PRODUCTION TECHNIQUES. - Objective 1: Describe greenhouse structures. - Objective 7: Explain the effects of light, temperature, and water on plant growth. - Objective 9: Propagate greenhouse crops. Greenhouse Management Precision Exams – Performance Skills Standards Standard 4 – Propagate plants using both seed and cuttings. AFNR – Plant Systems Standards · PS.01.01. Determine the influence of environmental factors on plant growth. - PS.01.01.01.b. Analyze and describe plant responses to light, color, intensity and duration. - PS.01.01.02.b. Determine the optimal air and temperature conditions for plant growth. · PS.03.01. Demonstrate plant propagation techniques in plant system activities. - PS.03.01.02.b. Handle seed to overcome seed dormancy mechanisms and to maintain seed viability and vigor. - PS.03.01.02.c. Conduct tests associated with seed germination rates, viability and vigor. - PS.03.01.03.a. Summarize optimal conditions for asexual propagation and demonstrate techniques used to propagate plants by cuttings, division, separation, layering, budding and grafting. - PS.03.01.03.b. Manage the plant environment to support asexual reproduction. - PS.03.01.03.c. Evaluate asexual propagation practices based on productivity and efficiency. · PS.03.02 Develop and implement a management plan for plant production.	

- PS.03.02.03.a. Determine seeding rate need for specific plant population or desired quantity of finished plants.
- PS.03.02.04.a. Observe and record environmental conditions during the germination, growth and development of a crop.

Aligned Washington State Learning Standards

Arts	
Computer Science	
Educational Technology	
English Language Arts	
Environment & Sustainability	
Financial Education	
Health and Physical Education	
Mathematics	N-RN Use properties of rational and irrational numbers. N-Q Reason quantitatively and use units to solve problems.
Science	
Social Studies	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

1. Examine the properties of growing media and describe the functions of each type used in greenhouse facility.
2. Test and determine pH level of various growing media and interpret the results.
3. Identify materials commonly used in soilless media and the benefits to plants.
4. Classify the three main nutrients (nitrogen, potassium, phosphorus) found in chemical fertilizer and identify evidence of nutrient deficiencies.
5. Identify and describe fertilizer components and the application methods (indoor and outdoor) used to provide nutrients to horticulture crops.

Leadership Alignment:

21st Century Skills

- 2.C.5. Interpret information and draw conclusions based on the best analysis. – Soil pH testing
8.B.1. Monitor, define, prioritize and complete tasks without direct oversight. – Fertilization application

Standards and Competencies

Unit 3: Growing Media and Plant Nutrition

Industry Standards and/or Competencies

Total Learning Hours for Unit: 7

Greenhouse Management Precision Exams – Knowledge Standards

Standard 3 – STUDENTS WILL DEMONSTRATE GREENHOUSE CROP PRODUCTION TECHNIQUES.

- Objective 4: Examine the components and properties of growing media.
- Objective 5: Investigate chemical characteristics of growing media.
- Objective 6: Supply nutrients to greenhouse crops.

AFNR – Plant Systems Standards

· PS.01.02. Prepare and manage growing media for use in plant systems.

- PS.01.02.01.a. Identify the major components of growing media and describe how growing media support plant growth.

- PS.01.02.01.b. Describe the physical and chemical characteristics of growing media and explain the influence they have on plant growth.
- PS.01.02.02.b. Discuss how soil drainage and water-holding capacity can be improved.
- 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.
 - PS.01.03.01.b. Analyze the effects 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.
 - PS.01.03.02.a. Discuss the influence of pH and cation exchange capacity on the availability of nutrients.
 - PS.01.03.04.a. Identify fertilizer sources of essential plant nutrients; explain fertilizer formulations, including organic and inorganic; and describe different methods of fertilizer application.
 - PS.01.03.04.b. Calculate the amount of fertilizer to be applied based on nutrient recommendation and fertilizer analysis.
 - PS.01.03.06.a. Summarize the impact of environmental factors on nutrient availability.
 - PS.01.03.06.b. Assess and describe the impact environmental factors have on a crop.

Aligned Washington State Learning Standards

Arts	
Computer Science	
Educational Technology	
English Language Arts	CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to texts and topics.
Environment & Sustainability	
Financial Education	
Health and Physical Education	
Mathematics	N-RN Use properties of rational and irrational numbers. N-Q Reason quantitatively and use units to solve problems. N-CN Perform arithmetic operations with complex numbers. A-REI Understand solving equations as a process of reasoning and explain the reasoning.
Science	
Social Studies	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

1. Identify, describe and properly care for ornamental plants grown in the greenhouse.
2. **Plant Care Brochure** – create a handout that outlines the proper care and management of plants for annual plant sale.
3. **Plant Identification Manual** – use identifying features and growth habits to identify each plant grown in the greenhouse by its common and scientific name.
4. Explain the purpose and benefits of keeping inventory and develop a method for tracking plant material in the greenhouse.

Leadership Alignment:

21st Century Skills

8.B.1. Monitor, define, prioritize and complete tasks without direct oversight. – plant care in the greenhouse

3.B.3. Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.- plant care in greenhouse and tracking inventory of plants
FFA Floriculture CDE – practice Plant Identification skills from list of plants.

Standards and Competencies

Unit 4: Plant Identification and Care

Industry Standards and/or Competencies

Total Learning Hours for Unit: 8

Greenhouse Management Precision Exams – Knowledge Standards
Standard 3 – STUDENTS WILL DEMONSTRATE GREENHOUSE CROP PRODUCTION TECHNIQUES.

- Objective 10: Grow greenhouse crops.

Standard 4 – STUDENTS WILL EXPLAIN GREENHOUSE BUSINESS CONCEPTS.

- Objective 3: Describe greenhouse business management.

Greenhouse Management Precision Exams – Performance Skills Standards

Standard 7 – Prepare greenhouse plants for sale.

AFNR – Plant Systems Standards

· PS.02.01. Classify plants according to taxonomic systems.

- PS.02.01.02.a. Describe the morphological characteristics used to identify agricultural and herbaceous plants.
- PS.02.01.02.b. Identify and describe important plants to agricultural and ornamental plant systems by common names.
- PS.02.01.02.c. Identify and describe important plants to agricultural and ornamental plant systems by scientific names.

· PS.04.01 Evaluating, identifying and preparing plants to enhance an environment.

- PS.04.01.01.a. Identify and categorize plants by the purpose.
- PS.04.01.01.b. Demonstrate proper use of plants in their environment.

Aligned Washington State Learning Standards

Arts	VA:Cr2.1.1.a. Engage in making a work of art or design without having a preconceived plan.
Computer Science	
Educational Technology	2.3.1 Select and use common applications.
English Language Arts	CCSS.ELA-LITERACY.WHST.9-10.6 Use technology, including the internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Environment & Sustainability	
Financial Education	
Health and Physical Education	
Mathematics	
Science	
Social Studies	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

1. Plan a growing schedule to maximize plant production in a greenhouse environment.
2. Identify the importance of proper spacing of greenhouse crops and recommend spacing practices on greenhouse tables.
3. Select the appropriate container and growing media needed for each greenhouse crop.
4. Explain the purpose of pinching greenhouse crops and demonstrate the proper techniques used.
5. Demonstrate proper watering techniques for a variety of horticulture crops.
6. **ID Greenhouse Pests and Diseases** - Properly identify pests and diseases and explain the best method for controlling and managing them.
7. Demonstrate safe practices in selecting, applying, storing, and disposing chemicals.
8. Explain the alternative pest control methods and integrated pest management practices that can be used in a greenhouse facility.

Leadership Alignment:21st Century Skills

- 8.B.1. Monitor, define, prioritize and complete tasks without direct oversight. – watering and pinching back plants in the greenhouse
- 3.B.3. Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.- growing plants on a schedule
- 11.B.1. Act responsibly with the interests of the larger community in mind. – controlling pests and applying pest control methods
- FFA Floriculture CDE – practice Pest and Disease Management practicum using standards.

Standards and Competencies**Unit 5: Plant Growth and Greenhouse Management****Industry Standards and/or Competencies****Total Learning Hours for Unit: 10**

Greenhouse Management Precision Exams – Knowledge Standards

Standard 3 – STUDENTS WILL DEMONSTRATE GREENHOUSE CROP PRODUCTION TECHNIQUES.

- Objective 2: Explain greenhouse climate control.
- Objective 3: Describe automated greenhouse systems.
- Objective 4: Examine the components and properties of growing media.
- Objective 7: Explain the effects of light, temperature, and water on plant growth.
- Objective 10: Grow greenhouse crops.
- Objective 11: Discuss pest management techniques.

Greenhouse Management Precision Exams – Performance Skills Standards

Standard 5 – Perform typical plant maintenance, transplanting, and watering.

Standard 6 – Develop a growing schedule to maximize the production of a greenhouse facility.

Standard 7 – Prepare greenhouse plants for sale.

AFNR – Plant Systems Standards

- PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.
 - PS.02.03.03.a. Summarize primary growth and the role of the apical meristem.
 - PS.02.03.03.b. Analyze plant growth and assess the process of secondary plant growth.
- PS.03.02. Develop and implement a management plan for plant production.
 - PS.03.02.01.b. Inspect propagation material for evidence of pests or disease.
- PS.01.01 Determine the influence of environmental factors on plant growth.
 - PS.01.01.03.a. Identify and summarize the effects of water quality on plant growth.
- PS.03.03. Develop and implement a plan for integrated pest management for plant production.
 - PS.03.03.01.a. Identify and categorize plant pests, diseases and disorders.

- PS.03.03.01.c. Devise solutions for plant pests, diseases and disorders.
- PS.03.03.02.a. Diagram the life cycle of major plant pests and diseases.
- PS.03.03.02.b. Predict pest and disease problems based on environmental conditions and life cycles.
- PS.03.03.02.c. Design and implement a crop scouting program.
- PS.03.03.03.a. Identify and summarize pest control strategies associated with integrated pest management and the importance of determining economic threshold.
- PS.03.03.03.b. Demonstrate pesticide formulations including organic and synthetic active ingredients and selection of pesticide to control specific pest.
- PS.03.03.03.c. Employ pest management strategies to manage pest populations, assess the effectiveness of the plan and adjust the plan as needed.
- PS.03.03.04.a. Distinguish between risks and benefits associated with the materials and methods used in plant pest management.
- PS.03.03.04.b. Examine and apply procedures for the safe handling, use and storage of pesticides including personal protective equipment and reentry interval.
- PS.03.05. Harvest, handle and store crops according to current industry standards.
 - PS.03.05.02.c. Implement and evaluate the effectiveness of plans to reduce crop loss.

ANFR – Career Ready Practices

- CRP.07.02.01.b. Assess data sources for reliability and validity.

Aligned Washington State Learning Standards

Arts	
Computer Science	
Educational Technology	
English Language Arts	
Environment & Sustainability	
Financial Education	
Health and Physical Education	H1.Sa1.HS Describe how to prevent occupational injuries.
Mathematics	
Science	
Social Studies	

COMPONENTS AND ASSESSMENTS

Performance Assessments:

1. Identify the four keys to marketing products including: product, placement, price and promotion.
2. Create greenhouse organization and management methods to meet the continuing needs of customers that purchase plants.
3. Research and compare marketing strategies used for horticulture sales and apply those to our annual plant sale.
4. Recognize costs related to greenhouse production and determine profit margin for individual plants.
5. Apply knowledge and sales skills to effectively interact with a customer at the annual plant sale.

Leadership Alignment:

21st Century Skills

- 7.A.1. Adapt to varied roles, job responsibilities, schedules and contexts. – greenhouse preparation for Plant Sale

7.B.2. Deal positively with praise, setbacks and criticism. – helping customers at Plant Sale
 9.A.2. Conduct themselves in a respectable, professional manner. – helping customers at Plant Sale
 FFA Floriculture CDE – practice One-on-One Sales practicum using standards.

Standards and Competencies

Unit 6: Greenhouse Marketing and Sales

Industry Standards and/or Competencies

Total Learning Hours for Unit: 7

Greenhouse Management Precision Exams – Knowledge Standards

Standard 4 – STUDENTS WILL EXPLAIN GREENHOUSE BUSINESS CONCEPTS.

- Objective 1: Prepare greenhouse crops for sale.
- Objective 2: Explain the basics of marketing in the greenhouse facility.
- Objective 3: Describe greenhouse business management.

Greenhouse Management Precision Exams – Performance Skills Standards

Standard 7 – Prepare greenhouse plants for sale.

AFNR – Plant Science

• PS.03.05. Harvest, handle and store crops according to current industry standards.

- PS.03.05.05.a. Summarize the reasons for preparing plants and plant products for distribution.
- PS.03.05.05.b. Demonstrate techniques for grading, handling and packaging plants and plant products for distribution.

AFNR – Career Ready Practices

• CRP.04.01. Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

- CRP.04.01.01.b. Analyze use of verbal and non-verbal communication strategies in workplace settings.
- CRP.04.01.02.b. Apply strategies for speaking with clarity. Logic, purpose and professionalism in a variety of situations in formal and informal settings.

• CRP.04.03. Model active listening strategies when interacting with others in formal and informal settings.

- CRP.04.03.01.b. Apply active listening strategies.

Aligned Washington State Learning Standards

Arts	VA:Cr2.3.I.a. Collaboratively develop a proposal for an installation, artwork, or space design that transforms the perception and experience of a particular place.
Computer Science	
Educational Technology	
English Language Arts	CCSS.ELA-LITERACY.WHST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations of accounts.
Environment & Sustainability	
Financial Education	
Health and Physical Education	
Mathematics	N-RN Use properties of rational and irrational numbers. N-Q Reason quantitatively and use units to solve problems. N-CN Perform arithmetic operations with complex numbers.
Science	

Social Studies	
COMPONENTS AND ASSESSMENTS	
Performance Assessments: 1. Identify and manipulate when required the climate and environmental requirements for growing vegetables in a greenhouse facility. 2. Compare and contrast production practices used for growing a variety of vegetables in a greenhouse setting including: soil, fertilizer, sunlight and temperature. 3. Grow and manage cool weather vegetable starts for local food banks. 4. Plan and create a Useful Garden Space utilizing knowledge and design skills gained from growing horticulture crops. 5. Identify fruit production and harvesting techniques used by growers that meet industry standards. 6. Fruit Production Presentation – outline the planting, production and long-term management of fruit crops grown in Whatcom County. 7. Identify and select proper pruning methods used in industry and apply those methods to managing fruit crops. 8. Research and apply proper methods for grafting fruit trees and learn to care for new growth.	
Leadership Alignment: 21st Century Skills 8.C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise. – Useful Garden Space and applying proper pruning and grafting methods 10.A.2. Prioritize, plan and manage work to achieve the intended result. – creating a Useful Garden Space	
Standards and Competencies	
Unit 7: Vegetable and Fruit Production	
Industry Standards and/or Competencies	Total Learning Hours for Unit: 8
Greenhouse Management Precision Exams – Knowledge Standards Standard 3 – STUDENTS WILL DEMONSTRATE GREENHOUSE CROP PRODUCTION TECHNIQUES. • Objective 7: Explain the effects of light, temperature, and water on plant growth. • Objective 10: Grow greenhouse crops. Greenhouse Management Precision Exams – Performance Skills Standards Standard 5 – Perform typical plant maintenance, transplanting, and watering. Standard 6 – Develop a growing schedule to maximize the production of a greenhouse facility. Standard 7 – Prepare greenhouse plants for sale. AFNR – Plant Systems Standards • PS.01.03. Develop and implement a fertilization plan for specific plants or crops. • PS.01.03.05.b. Assess and describe the short and long-term effects production methods have on soil. • PS.01.03.06.b. Assess and describe the impact environmental factors have on a crop. • PS.03.05. Harvest, handle and store crops according to current industry standards. • PS.03.05.03.a. Research and summarize how safety is ensured at each stage of the following processes: harvesting, processing and storing. • PS.03.05.03.b. Research and analyze practices used to maintain a safe product through harvest, processing, storage and shipment. • PS.03.05.04.a. Identify and categorize plant preparation methods for storing and shipping plants and plant products. • PS.03.05.05.a. Summarize the reasons for preparing plants and plant products for distribution. • PS.03.05.05.b. Demonstrate techniques for grading, handling and packaging plants and plant products for distribution.	

· PS.03.01 Demonstrate plant propagation techniques in plant system activities. PS.03.01.03.a. Summarize optimal conditions for asexual propagation and demonstrate techniques used to propagate plants by cuttings, division, separation, layering, budding and grafting.	
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Aligned Washington State Learning Standards	
Arts	VA:Cr2.1.I.a. Engage in making a work of art or design without having a preconceived plan.
Computer Science	
Educational Technology	2.3.1 Select and use common applications.
English Language Arts	
Environment & Sustainability	
Financial Education	
Health and Physical Education	
Mathematics	
Science	
Social Studies	

COMPONENTS AND ASSESSMENTS	
Performance Assessments: - Apply knowledge of plant care and production methods to grow vegetable starts for planting at a Home Garden Space. - Record SAE Project on the AET System - Identify FFA Opportunities related to classroom content.	
Leadership Alignment: - SAE Development - Analyze SAE project and develop goals for its continued growth. - Manage project to be effective and accountable for documentation. - Opportunities in the FFA Floriculture CDE.	
Standards and Competencies	
Unit 8: FFA and SAE	
Industry Standards and/or Competencies	Total Learning Hours for Unit: 6
Greenhouse Management Precision Exams – Knowledge Standards Standard 1 – STUDENTS WILL DEVELOP PERSONAL, LEADERSHIP, AND CAREER SKILLS THROUGH FFA PARTICIPATION. - Objective 1: Assess the role of FFA participation in developing personal and leadership skills. - Objective 2: Assess the role of FFA participation in developing career skills. Standard 2 – STUDENTS WILL EXPLAIN THE MAINTENANCE AND EXPANSION OF SUPERVISED AGRICULTURAL EXPERIENCE (SAE) PROGRAMS. - Objective 1: Maintain and use SAE records. - Objective 2: Devise long-range plans for expanding SAE programs. Greenhouse Management Precision Exams – Performance Skills Standards 2 – Develop short and long range leadership and personal development goals.	

Aligned Washington State Learning Standards	
Arts	
Computer Science	
Educational Technology	2.3.2 Select and use online applications.
English Language Arts	
Environment & Sustainability	
Financial Education	
Health and Physical Education	
Mathematics	
Science	
Social Studies	

The 21st Century Skills should be taught and assessed throughout the course. This table should be included at the end of this document.

21 st Century Skills		
Check those that students will demonstrate in this course:		
LEARNING & INNOVATION Creativity and Innovation ☐ Think Creatively ☐ Work Creatively with Others ☐ Implement Innovations Critical Thinking and Problem Solving ☒ Reason Effectively ☐ Use Systems Thinking ☒ Make Judgments and Decisions ☐ Solve Problems Communication and Collaboration ☐ Communicate Clearly ☒ Collaborate with Others	INFORMATION, MEDIA & TECHNOLOGY SKILLS Information Literacy ☐ Access and /evaluate Information ☐ Use and Manage Information Media Literacy ☐ Analyze Media ☐ Create Media Products Information, Communications and Technology (ICT Literacy) ☐ Apply Technology Effectively	LIFE & CAREER SKILLS Flexibility and Adaptability ☒ Adapt to Change ☒ Be Flexible Initiative and Self-Direction ☐ Manage Goals and Time ☒ Work Independently ☒ Be Self-Directed Learners Social and Cross-Cultural ☒ Interact Effectively with Others ☐ Work Effectively in Diverse Teams Productivity and Accountability ☒ Manage Projects ☒ Produce Results Leadership and Responsibility ☐ Guide and Lead Others ☒ Be Responsible to Others