Introduction to Plant Systems

8007/36 weeks

Table of Contents

Acknowledgments ................................................................................................................................... 1
Course Description .................................................................................................................................. 2
Task Essentials Table .............................................................................................................................. 2
Curriculum Framework .......................................................................................................................... 4
Exploring Leadership Opportunities through FFA .................................................................................... 4
Introducing Botany .................................................................................................................................. 8
Understanding Plant Processes ............................................................................................................. 11
Evaluating the Environmental Stimuli that Affect Plant Growth and Development ............................................. 13
Demonstrating Sexual Propagation in the Production of Plants ......................................................................... 16
Demonstrating Methods of Asexual Propagation in the Production of Plants .................................................... 18
Managing Plants: Soil and Soilless Growing Systems ..................................................................................... 21
Investigating the Principles of Plant Nutrition ............................................................................................. 23
Using Basic Scientific Principles in Plant Pest Management ........................................................................... 25
Using Basic Scientific Skills and Principles in Plant Selection ........................................................................ 28
Incorporating Mechanical Skills Related to the Plant Systems Pathway ......................................................... 31
SOL Correlation by Task Table ................................................................................................................... 36
FFA Information ................................................................................................................................... 39
Entrepreneurship Infusion Units ................................................................................................................. 40
Appendix: Credentials, Course Sequences, and Career Cluster Information ....................................................... 41

Acknowledgments

The components of this instructional framework were developed by the following curriculum development panelists:

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- Dr. Joyce Latimer, Professor, School of Plant and Environmental Sciences, Virginia Tech, Blacksburg
Course Description

Suggested Grade Level: 9 or 10

Students develop competencies in each of the major areas of the Plant Systems career pathway, including applied botany, plant propagation, and plant care and selection. Instructional content also includes an introduction to the various aspects of the plant systems industry. Students learn agricultural mechanics applicable to plant systems. Additionally, students will be given instruction on the principles of leadership and provided Supervised Agricultural Experience (SAE) opportunities.

As noted in Superintendent's Memo #058-17 (2-28-2017), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.

Task Essentials Table

- Tasks/competencies designated by plus icons (➕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (〇) are optional
- Tasks/competencies designated by minus-circle icons (🚫) are omitted
- Tasks marked with an asterisk (*) are sensitive.

<table>
<thead>
<tr>
<th>8007 Task</th>
<th>Exploring Leadership Opportunities through FFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Identify the role of supervised agricultural experiences (SAEs) in agricultural education.</td>
</tr>
<tr>
<td></td>
<td>Task</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>40</td>
<td>Participate in an SAE.</td>
</tr>
<tr>
<td>41</td>
<td>Identify the benefits and responsibilities of FFA membership.</td>
</tr>
<tr>
<td>42</td>
<td>Describe leadership characteristics and opportunities as they relate to agriculture and FFA.</td>
</tr>
<tr>
<td>43</td>
<td>Apply for an FFA degree and/or an agricultural proficiency award.</td>
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</tbody>
</table>

**Introducing Botany**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>Explain the importance of plant taxonomy.</td>
</tr>
<tr>
<td>45</td>
<td>Identify major plant parts and their primary functions.</td>
</tr>
<tr>
<td>46</td>
<td>Explain the characteristics of plants.</td>
</tr>
<tr>
<td>47</td>
<td>Differentiate between plant life cycles based on classification.</td>
</tr>
<tr>
<td>48</td>
<td>Describe the growth stages of a plant.</td>
</tr>
<tr>
<td>49</td>
<td>Illustrate the importance of plant systems in relation to humans.</td>
</tr>
<tr>
<td>50</td>
<td>Discuss the major disciplinary fields of plant agriculture.</td>
</tr>
<tr>
<td>51</td>
<td>Research innovative plant breeding technologies.</td>
</tr>
</tbody>
</table>

**Understanding Plant Processes**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>Explain the life-sustaining processes by which all plants grow and develop.</td>
</tr>
<tr>
<td>53</td>
<td>Explain the process of osmosis.</td>
</tr>
<tr>
<td>54</td>
<td>Explain the process of diffusion.</td>
</tr>
</tbody>
</table>

**Evaluating the Environmental Stimuli that Affect Plant Growth and Development**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>Evaluate the effect of light on plants.</td>
</tr>
<tr>
<td>56</td>
<td>Evaluate the effect of temperature on plants.</td>
</tr>
<tr>
<td>57</td>
<td>Evaluate the effect of water on plants.</td>
</tr>
<tr>
<td>58</td>
<td>Evaluate types and components of greenhouses and other indoor plant-growing facilities.</td>
</tr>
</tbody>
</table>

**Demonstrating Sexual Propagation in the Production of Plants**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>Examine the advantages and disadvantages of sexual propagation in the development of new plant varieties.</td>
</tr>
<tr>
<td>61</td>
<td>Plant seeds using various methods.</td>
</tr>
<tr>
<td>62</td>
<td>Analyze scarification and stratification methods that aid in the propagation process.</td>
</tr>
<tr>
<td>63</td>
<td>Describe the germination process.</td>
</tr>
<tr>
<td>64</td>
<td>Calculate the germination rates of seeds.</td>
</tr>
<tr>
<td>65</td>
<td>Demonstrate how to transplant seedlings.</td>
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</tbody>
</table>

**Demonstrating Methods of Asexual Propagation in the Production of Plants**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>Examine the advantages and disadvantages of asexual propagation in the production of plants.</td>
</tr>
<tr>
<td>67</td>
<td>Demonstrate how to produce plants through cuttings.</td>
</tr>
<tr>
<td>68</td>
<td>Demonstrate how to produce plants by layering.</td>
</tr>
<tr>
<td>69</td>
<td>Demonstrate how to produce plants through division and separation.</td>
</tr>
<tr>
<td>70</td>
<td>Describe grafting and budding techniques for woody and herbaceous plants.</td>
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<tr>
<td>71</td>
<td>Describe how to produce plants through micropropagation.</td>
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<tr>
<td>72</td>
<td>Evaluate cultural practices for vegetable crops grown in a greenhouse.</td>
</tr>
</tbody>
</table>

**Managing Plants: Soil and Soilless Growing Systems**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>Evaluate the physical and chemical properties of soil and soilless substrates.</td>
</tr>
<tr>
<td>74</td>
<td>Amend substrates for optimal plant growth.</td>
</tr>
<tr>
<td>75</td>
<td>Collect a soil sample for evaluation.</td>
</tr>
<tr>
<td>76</td>
<td>Analyze soil sample for nutrients and pH.</td>
</tr>
<tr>
<td>77</td>
<td>Describe hydroponic, aquaponic, and aeroponic plant production.</td>
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</tbody>
</table>

**Investigating the Principles of Plant Nutrition**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>Evaluate the effects of primary and secondary macronutrients on plant growth and development.</td>
</tr>
<tr>
<td>79</td>
<td>Evaluate the effects of micronutrients on plant growth and development.</td>
</tr>
<tr>
<td>80</td>
<td>Diagnose nutrient deficiencies in plants.</td>
</tr>
<tr>
<td>81</td>
<td>Describe fertilizer application methods.</td>
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</tbody>
</table>

**Using Basic Scientific Principles in Plant Pest Management**

<table>
<thead>
<tr>
<th></th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>Identify the common invertebrates that affect plant growth and development.</td>
</tr>
<tr>
<td>83</td>
<td>Identify abiotic and biotic factors influencing plant growth and development.</td>
</tr>
<tr>
<td>84</td>
<td>Classify common weeds that affect plant growth.</td>
</tr>
</tbody>
</table>
Classify types of vertebrate pests that affect plant growth.

Explain methods of plant pest management.

Interpret the information on a pesticide label.

Identify the application of different types of pesticides.

Identify U.S. Department of Agriculture (USDA) plant hardiness zones and how they affect plant selection.

Evaluate the common tree species of Virginia.

Evaluate the common species of agronomic plants grown in Virginia.

Evaluate common species of fruits and vegetables grown in Virginia.

Evaluate common species of nursery and landscape horticulture plants grown in Virginia.

Evaluate common species of turfgrass grown in Virginia.

Evaluate common species of floriculture crops grown in Virginia.

Demonstrate safety practices and procedures in various areas associated with agricultural mechanics in plant systems.

Demonstrate equipment safety and operation as they relate to the plant systems pathway.

Demonstrate standard measurement techniques in plant systems.

Demonstrate drawing for agricultural mechanics as it relates to the plant systems pathway.

Examine metalworking operations as they relate to the plant systems pathway.

Examine woodworking operations as they relate to the plant systems pathway.

Examine electrical operations as they relate to the plant systems pathway.

Examine small-engine operations as they relate to the plant systems pathway.

Examine plumbing operations as they relate to the plant systems pathway.

Legend: ✤ Essential ○ Non-essential ☐ Omitted

Curriculum Framework

Exploring Leadership Opportunities through FFA

Note: Competencies 39-43 have been added to ensure compliance with federal legislation: National FFA Organization's Federal Charter Amendments Act (Public Law 116-7, https://www.congress.gov/116/plaws/publ7/PLAW-116publ7.pdf). All inquiries may be sent to cte@doe.virginia.gov. Students are provided opportunities for leadership, personal growth, and career success. Instruction is delivered through three major components: classroom and laboratory instruction, supervised agricultural experience (SAE) program, and student leadership (FFA).

Task Number 39
Identify the role of supervised agricultural experiences (SAEs) in agricultural education.

Definition

Identification should include

- defining an SAE program as an opportunity for students to consider multiple careers and occupations in the agriculture, food, and natural resources (AFNR) industries, learn expected workplace behavior, develop specific skills within an industry, and apply academic and occupational skills in the workplace or a simulated workplace environment
- researching the Foundational SAE
  - career exploration and planning
  - personal financial planning and management
  - workplace safety
  - employability skills for college and career readiness
  - agricultural literacy
- researching the Immersion SAE
  - entrepreneurship/ownership
  - placement/internships
  - research (experimental, analytical, invention)
  - school business enterprises
  - service learning
- developing a plan to participate in an SAE, based on personal and career goals
- researching available awards and degrees, based on SAE participation.

Teacher resource: SAE Resources, National Council for Agricultural Education

Process/Skill Questions

- What are examples of SAEs related to this course and in the AFNR industries?
- Where can a copy of the Virginia SAE Record Book be found?
- What is an Immersion SAE?
- How does a placement/internship SAE differ from an ownership/entrepreneurship SAE?
- How does an SAE provide relevant work experience and contribute to the development of critical thinking skills?
- How is the SAE an extended individualized instructional component of a student’s Career Plan of Study?
- How can an SAE be used to provide evidence of student growth and participation in authentic, work-related tasks?
- What are the four types of SAEs?
- What are the advantages of participating in work-based learning experiences and projects?
- How does one choose an appropriate SAE in which to participate?

Task Number 40

Participate in an SAE.

Definition

Participation should include

- developing, completing, or continuing a plan to participate in an SAE as a work-based learning experience, based on personal and career goals
- documenting experience, connections, positions held, and competencies attained, using the Virginia SAE Record Book
- researching available awards and degrees, based on SAE participation.
Teacher resources:
- FFA SAE
- The Agricultural Experience Tracker

Process/Skill Questions
- What are the advantages of participating in work-based learning experiences and projects?
- How do SAEs help prepare students for the workforce?
- What are some examples of SAEs in AFNR?

Task Number 41
Identify the benefits and responsibilities of FFA membership.

Definition
Identification should include
- benefits
  - listing opportunities to participate in community improvement projects and career development events (CDEs) and leadership development events (LDEs)
  - exploring leadership development opportunities
- responsibilities
  - researching the responsibilities of FFA officers, committees, and members
  - locating resources that guide participation in FFA activities
  - explaining the FFA Creed, Motto, Salute, and mission statement
  - explaining the meaning of the FFA emblem, colors, and symbols
  - explaining significant events and the history of the organization.

Process/Skill Questions
- How does one become an FFA member?
- What is the FFA’s mission and how does it accomplish its mission?
- What are the benefits and responsibilities of FFA membership?
- What five FFA activities are available through the local chapter?
- What are some significant events in FFA history? How have these events shaped membership over time?
- What is the FFA program of activities (POA), and how is it used?

Task Number 42
Describe leadership characteristics and opportunities as they relate to agriculture and FFA.

Definition
Description should include
- examples of successful leaders
- types of leadership
  - autocratic
  - participative
  - laissez-faire
servant
o followership
• positive leadership qualities and traits of successful leaders
• opportunities for participating in leadership activities in FFA
• demonstrating methods for conducting an effective meeting.

Process/Skill Questions

• Who are some successful leaders in the agriculture industry?
• What qualities make a successful leader?
• What are leadership traits?
• What is the difference between positive and negative leadership?

Task Number 43

Apply for an FFA degree and/or an agricultural proficiency award.

Definition

Application should include

• identifying types of FFA degrees
  o Greenhand
  o Chapter
  o State
  o American
• identifying proficiency award areas
  o entrepreneurship
  o placement
  o combined
  o agriscience research
• exploring CDEs and LDEs related to this course
• identifying all SAE criteria to be eligible for the award
• identifying the type of award
• applying for an FFA award.

Teacher resource: FFA Agricultural Proficiency Awards

Process/Skill Questions

• Where are the awards and their application criteria located?
• What are the benefits of winning an FFA award?
• What are the benefits and requirements of an FFA degree?
• What FFA awards are available?
• How does the FFA degree program reward FFA members in all phases of leadership, skills, and occupational development?
• What is the highest degree that can be conferred upon an FFA member at the national level?
• What are the requirements for a Greenhand FFA degree?
Introducing Botany

Task Number 44

Explain the importance of plant taxonomy.

Definition
Explanation should include classifying plants by

- kingdom
- division
- class
- order
- family
- genus
- species
- variety
- cultivar.

Process/Skill Questions

- What is taxonomy?
- Why is taxonomy important?
- What are the components of plant taxonomy?

Task Number 45

Identify major plant parts and their primary functions.

Definition
Identification should include

- roots
- stems
- leaves
- flowers
- fruits
- seeds.

Process/Skill Questions

- What parts of a plant are involved in reproduction?
- What parts of a plant are involved in respiration?
- What are the signs that a plant has reached maturity?
- What is juvenile growth?
- What is the usefulness of modification in plant parts?
- What are the different types of roots?
Task Number 46

Explain the characteristics of plants.

**Definition**
Explanation should include:

- discussing the importance of scientific naming, classification, and taxonomy
- differentiating among genus, species, variety, and cultivar
- describing tissue characteristics, cellular characteristics, and physical characteristics.

**Process/Skill Questions**

- What are the benefits of knowing the plant kingdom and the major plant characteristics?
- What is the difference between an autotroph and a heterotroph?
- What is the process for identifying a plant using a dichotomous key?
- What are some methods used to identify plants?
- What are plant allies?

Task Number 47

Differentiate between plant life cycles based on classification.

**Definition**
Differentiation should include:

- mosses
- ferns
- gymnosperms (cone-bearing)
- angiosperms (flower-bearing).

**Process/Skill Questions**

- What is a diploid?
- What is a haploid?
- Where does fertilization take place in the moss life cycle?
- What is a spore?
- What is a sporophyte?
- What is a gametophyte?
- What is a gamete?

Task Number 48

Describe the growth stages of a plant.

**Definition**
Description should include:

- sprout
- seedling
- vegetative
- budding
- flowering
• ripening
• dormancy
• maturity
• reproduction
• comparison of annual, biennial, and perennial growth cycles.

Process/Skill Questions

• What is an annual plant?
• What is a biennial plant?
• What is a perennial plant?
• What are examples of plants that are annuals?
• What are examples of plants that are biennials?
• What are examples of plants that are perennials?
• What is senescence?
• What are herbaceous perennials?
• What are the six plant growth stages?

Task Number 49

Illustrate the importance of plant systems in relation to humans.

Definition
Illustration should include

• food chain
• fiber production
• ornamentation
• energy
• economics
• environment
• medical
• housing
• recreation
• impact on mental and emotional well-being.

Process/Skill Questions

• How do humans use plants?
• How are plants used for medicinal purposes?
• What types of plants are considered beneficial plants in your community and why?
• What plants are used in fiber production?
• How have selected plant systems contributed to your community’s economy?
• How have selected plant systems contributed to Virginia’s economy?
• How have selected plant systems contributed to the United States’ economy?
• Why are seed banks and seed libraries important?

Task Number 50

Discuss the major disciplinary fields of plant agriculture.

Definition
Discussion should include
• agronomy
• genetics
• soil science
• soil chemistry
• plant physiology
• entomology
• plant pathology
• forestry
• silviculture
• horticulture
• botany
• turfgrass.

Process/Skill Questions

• What is agronomy? Forestry? Horticulture? Botany? Turfgrass?
• What percentage of your community is employed in agronomic jobs? Forestry jobs? Horticulture jobs? Botany jobs? Turfgrass jobs?
• What employment opportunities exist in the agronomy, horticulture, forestry, botany, and turfgrass areas?
• Which area shows the most potential for employment?
• What impact do plants have on a community from a recreational standpoint?

Task Number 51

Research innovative plant breeding technologies.

Definition
Research may include

• the difference between natural selection, artificial selection, and bioengineering
• new breeding techniques
  o precision breeding
  o cell biology
  o gene mapping
  o marker-assisted breeding
  o gene editing
  o plant tissue culture.

Process/Skill Questions

• What is a GMO?
• How does bioengineering help ensure an adequate food supply for the population?
• What careers are available in the bioengineering field?

Understanding Plant Processes

Task Number 52

Explain the life-sustaining processes by which all plants grow and develop.

Definition
Explanation should include
• photosynthesis reactants and products
• cellular respiration reactants and products
• transpiration
• carbon fixation metabolism (e.g., C3, C4, Crassulacean acid metabolism [CAM]).

Process/Skill Questions

• What organisms within plant structures are involved in photosynthesis? In respiration? In transpiration?
• How do plants store energy?
• What role does the vascular system play in food transport within a plant?
• How does climate change put additional stress on crops?
• How are shifting growing patterns influencing new insect and weed threats that damage harvests?
• Why is it important to protect innovation in plant breeding?
• Which of the three metabolisms would work best in specific growing conditions?

Task Number 53

Explain the process of osmosis.

Definition
Explanation should include

• the definition of
  o osmosis
  o solute
  o solvent
  o solution
• a discussion on the diffusion of water molecules from an area of high to low concentration through a semi-permeable barrier such as the cell membrane
• osmotic pressure and the results of different types of solutions (e.g., hypertonic, hypotonic, isotonic).

Process/Skill Questions

• What is osmosis?
• What is a concentration gradient?
• How does osmosis affect the life of a plant?
• What is turgor pressure?
• How does turgor pressure affect the outward appearance of a plant (turgid/flaccid)?
• What is plasmolysis?
• How can plasmolysis impact plant production?
• How is osmosis used by cells?
• What is the function of membranes in osmosis?
• How do solute and solvent concentrations affect osmosis?
• What is plasmolysisation?
• How does saturation affect osmosis?
• How are diffusion and osmosis different?
• What other factors affect osmosis? How?
Task Number 54

Explain the process of diffusion.

Definition
Explanation should include

- the movement of a substance from an area of high to low concentration
- passive diffusion
- facilitated diffusion
- active transport
- passive transport.

Process/Skill Questions

- How does diffusion take place in plants?
- Why is diffusion important in plants?
- What role does diffusion play in photosynthesis?
- What is the difference between active transport and facilitated diffusion?
- What is the difference between passive diffusion and passive transport?

Evaluating the Environmental Stimuli that Affect Plant Growth and Development

Task Number 55

Evaluate the effect of light on plants.

Definition
Evaluation should be made by conducting experiments, incorporating the scientific method, that may involve variables in

- light duration
- light intensity
- light quality (color).

Process/Skill Questions

- What impact does light have on plants?
- Why can most plants not be grown in the dark?
- What role does light duration, intensity, and quality play in plant growth and development?
- What role do phytochromes play in seed germination, and the transition from vegetative to reproductive growth?
- Why is light quality important?
- When is there a need for a balanced light spectrum?
- What role does photoperiodism play in plant reproduction and growth?
Task Number 56

Evaluate the effect of temperature on plants.

Definition
Evaluation should be made by conducting experiments, incorporating the scientific method, and incorporating variables to include

- heating
- cooling
- shading systems
- cool-season vs. warm-season plants
- warm-loving vs. frost-tolerant plants
- tropical vs. subtropical plants.

Process/Skill Questions

- How can temperature affect biochemical reactions?
- What are the differences between cool-season crops and warm-season crops?
- What is hardening-off and why is it important?
- When are dormant plants impacted by temperature?
- How does cold damage occur?
- What symptoms will a plant display if it is exposed to excessive cold or heat?
- What effect does temperature have on plant dormancy?
- Why is plant-temperature tolerance important to know?
- How does temperature affect the germination rate?

Task Number 57

Evaluate the effect of water on plants.

Definition
Evaluation should be made by conducting experiments, incorporating the scientific method, that involve variables in

- drought resistance
- water quality
- irrigation systems
- relative humidity.

Process/Skill Questions

- What are some examples of drought-resistant plants?
- What are the advantages and disadvantages of different types of irrigation systems?
- What factors influence irrigation system selection?
- How does relative humidity affect the production of plants?
- How does water quality affect plant growth?
Task Number 58

Evaluate the effect of carbon dioxide (CO₂), oxygen, and airflow on plants.

Definition
Evaluation should be made by conducting experiments, incorporating the scientific method, that involve variables in

- air quality
- CO₂ levels in plant production
- plant spacing
- air circulation
- the greenhouse effect.

Process/Skill Questions

- What are the components of air quality in relation to plants?
- What are the effects of air pollutants such as NOₓ, SO₂, O₃, on plant growth and development?
- How does CO₂ concentration affect photosynthesis?
- How does airflow impact plant growth?
- What is the greenhouse effect?
- How do C₃, C₄, and CAM plants respond to elevated levels of CO₂?

Task Number 59

Evaluate types and components of greenhouses and other indoor plant-growing facilities.

Definition
Evaluation should include

- comparing greenhouse styles, including Quonset, gutter-connected, and retractable-roof
- contrasting glazing, including glass, polyethylene, acrylic, and polycarbonate
- describing benches and beds, including benching arrangements, bench materials, roll-out beds, and floor production
- describing developments in emerging indoor plant growing facilities (e.g., urban structures, warehouses, shipping containers, repurposed structures).

Process/Skill Questions

- What are the different styles of greenhouses?
- What are the advantages and disadvantages of the different styles of greenhouses?
- What is the difference between a high tunnel and a greenhouse?
- What are other examples of environmental control systems that can be used for plant production?
- What are the advantages and disadvantages of the following: cold frames, attached greenhouses, detached greenhouses, hotbeds, and lath houses?
- What are the primary plants grown in a greenhouse setting? Why?
- What is the economic importance of the greenhouse industry?
Demonstrating Sexual Propagation in the Production of Plants

Task Number 60

Examine the advantages and disadvantages of sexual propagation in the development of new plant varieties.

Definition
Examination should include

- impacts on production
- economic value
- hybridization
- effects on genetic diversity.

Process/Skill Questions

- What does the process of sexual propagation in plants entail?
- What is the result of sexual propagation?
- What are the economic benefits of propagating from seeds?
- How are plants produced from seed genetically different from those produced using asexual propagation?
- What is plant variety protection?

Task Number 61

Plant seeds using various methods.

Definition
Planting should include

- demonstration of planting seeds according to instructions and requirements
- different methods of seed dispersal.

Process/Skill Questions

- How are seeds dispersed in nature?
- How should seeds be planted for maximum germination?
- What are the environmental requirements for germination?
- How do heat and moisture affect germination rates of seeds?
- What practices can be used to increase germination rates in seeds?
Task Number 62

Analyze scarification and stratification methods that aid in the propagation process.

Definition
Analysis should include
- definition of scarification and stratification
- description of why these methods are important for the production of specific crops
- methodology of seed treatment.

Process/Skill Questions
- Why are scarification and stratification necessary for some seeds to germinate?
- What processes or tools can be used to scarify seeds?
- What are the benefits of the scarification method?
- What methods of stratification are used in the commercial production of plants?
- What are the benefits of the stratification method?

Task Number 63

Describe the germination process.

Definition
Description should include the steps of the germination process, including factors that can affect the process.

Process/Skill Questions
- What are the requirements for germination?
- What environmental factors control germination?
- What are the stages of germination?
- What part of the plant emerges first?
- What is germination rate?

Task Number 64

Calculate the germination rates of seeds.

Definition
Calculation should include a test of germination percentages over fixed durations.

Process/Skill Questions
- How does one measure a rate?
- How does one calculate a percentage?
- Why is germination rate important?
- Why is a germination test date important?
- Where is the germination rate and test date found?
- How does allelopathy affect germination rates?
Task Number 65

Demonstrate how to transplant seedlings.

Definition
Demonstration should include best practices in
- sanitation of materials, tools, and equipment
- recommended transplanting techniques
- care for seedlings after transplanting (e.g., watering).

Process/Skill Questions
- When should you transplant a seedling?
- How should you handle a seedling?
- Why should you transplant seedlings?
- What are the effects of transplant stress?
- What care should be taken with transplants to reduce stress and improve growth?
- Why is it important to clean and sanitize recycled containers before transplanting a seedling?

Demonstrating Methods of Asexual Propagation in the Production of Plants

Task Number 66

Examine the advantages and disadvantages of asexual propagation in the production of plants.

Definition
Examination should include
- impacts on plant production
- economic value of cloning plants.

Process/Skill Questions
- What is asexual propagation?
- How does asexual propagation affect biodiversity?
- What is the value of asexual propagation to the plant industry?
- What is a plant patent?
- How do plant patents and trademarked plants affect commercial growers?
- How does asexual reproduction limit the evolutionary process?
Task Number 67

Demonstrate how to produce plants through cuttings.

Definition
Demonstration may include using

- leaf cuttings
- stem cuttings
- root cuttings
- hardwood or softwood cuttings.

Process/Skill Questions

- What are the sanitary procedures to follow when taking cuttings?
- What determines the type of cutting you should take?
- How should you care for recent cuttings?
- What is a rooting hormone? Why should it be used?
- When should cuttings be transplanted?

Task Number 68

Demonstrate how to produce plants by layering.

Definition
Demonstration may include methods of

- air layering
- tip layering
- mound layering (e.g., for blackberries, rubber plants).

Process/Skill Questions

- What is layering?
- What is the purpose of layering?
- What are the steps to follow when using layering in plant reproduction?
- What types of plants respond best to layering methods?
- How do environmental conditions affect the success of layering?

Task Number 69

Demonstrate how to produce plants through division and separation.

Definition
Demonstration should include

- procedure for separation
- procedure for division
- appropriate plant species for each method (e.g., day lilies, hosta, cannas, ornamental grasses).
Process/Skill Questions

- Why are plants separated?
- What are the steps to follow when dividing or separating plants?
- What are the indicators of when a plant can be divided or separated?
- What are the benefits of division to the parent plant?
- When is the best time of year to divide plants?

Task Number 70

Describe grafting and budding techniques for woody and herbaceous plants.

Definition
Description should include

- a variety of grafting/budding techniques
- equipment needed to propagate plants
- plant species appropriate for each propagation method (e.g., tomatoes, apple trees, roses, Japanese maples, grapes).

Process/Skill Questions

- What are grafting and budding?
- Why do agriculturists use grafting or budding?
- What are the steps to follow for grafting or budding?
- What tools and equipment are necessary for grafting and budding?
- How do you care for grafts?
- What is scion wood?
- What is rootstock?
- How can rootstocks affect the growth rate, mature size, and production of grafted plants?

Task Number 71

Describe how to produce plants through micropropagation.

Definition
Description should include using a lab-based procedure involving tissue culture of popular house plants (e.g., African violets, day lilies, ferns).

Process/Skill Questions

- What is micropropagation?
- Why do agriculturists use micropropagation?
- What are the steps to follow for micropropagation?
- What materials are necessary to perform micropropagation?
- Why is a sterile environment critical to micropropagation?
Task Number 72

Evaluate cultural practices for vegetable crops grown in a greenhouse.

Definition
Evaluation should include

- pruning
- removal of unwanted growth points, suckers, and runners
- removal of old and undesirable leaves
- removal of undesirable fruit and produce
- training and trellising
- nutrient management
- pest management
- disease management
- light management
- temperature management
- humidity management
- harvesting methods
- post-harvest handling.

Process/Skill Questions

- What are some vegetable crops commonly grown in greenhouses?
- What are the advantages of greenhouse production vs. traditional field-grown production?
- What are common types of container production for greenhouse crops?
- How do hybrids developed for the greenhouse differ from the heirloom varieties?
- What pests are common to greenhouse crops?
- What diseases are common to greenhouse crops?
- What are some integrated pest management (IPM) methods for greenhouse pests and diseases?
- How can the need for light be addressed in year-round greenhouse production?
- For which greenhouse crops is pruning a desirable practice?

Managing Plants: Soil and Soilless Growing Systems

Task Number 73

Evaluate the physical and chemical properties of soil and soilless substrates.

Definition
Evaluation should include identifying

- physical properties of soilless substrates
  - bulk density
  - moisture content
Process/Skill Questions

- What are the important characteristics of soil?
- How is land classified?
- What is the composition of the ideal soil?
- What are four things that plants receive from soil?
- What components are commonly used in potting media, and what are their functions?

Task Number 74

Amend substrates for optimal plant growth.

Definition
Amendment should include commonly used materials that aid in drainage, aeration, and moisture retention. Amendment should also include organic and inorganic soil amendments (e.g., limestone, compost).

Process/Skill Questions

- What are some examples of amendments used to increase moisture retention?
- What are some common amendments used in the landscaping industry?
- What are some common components used to create soilless substrates?
- What are some examples of amendments used to increase drainage in soilless substrates?

Task Number 75

Collect a soil sample for evaluation.

Definition
Collection should include
• determining when to sample the soil
• using necessary sampling tools and equipment
• following best practices for soil sampling to ensure reliable results.

Process/Skill Questions

• Where can you obtain a soil test kit? Why is following the kit's directions important?
• Why is soil testing important?
• How do you collect a reliable soil sample?
• How do you prepare soil for testing?
• Why is it important to use clean tools when soil sampling?
• What tools and equipment are needed to collect soil samples?

Task Number 76

Analyze soil sample for nutrients and pH.

Definition
Analysis may include

• use of commercial soil test kit
• use of private lab or extension facilities.

Process/Skill Questions

• What macronutrients and micronutrients are evaluated in a soil sample? Why?
• What is the ideal pH range of soil?
• What is the electrical conductivity (EC) of soil and why is this important to know?

Task Number 77

Describe hydroponic, aquaponic, and aeroponic plant production.

Definition
Description should include an explanation of the production of plants using conventional, hydroponic, aquaponic, and aeroponic techniques.

Process/Skill Questions

• What are the advantages and disadvantages of each system?
• What are the key components of hydroponic, aquaponic, and aeroponic systems?
• What are examples of each system and how does each operate?

Investigating the Principles of Plant Nutrition
Task Number 78

Evaluate the effects of primary and secondary macronutrients on plant growth and development.

Definition
Evaluation should include identifying primary and secondary macronutrients and listing their effects on plant growth and development.

Process/Skill Questions
- Which three primary macronutrients are essential for plant growth?
- Why is N-P-K expressed as a ratio in fertilizer?
- What are the symptoms of various nutrient deficiencies?
- How can one treat a nutrient deficiency?
- What secondary macronutrients are essential for plant growth?

Task Number 79

Evaluate the effects of micronutrients on plant growth and development.

Definition
Evaluation should include identifying essential micronutrients and listing their effects on plant growth and development.

Process/Skill Questions
- What 10 essential micronutrients do plants need?
- What role do micronutrients play in plant health?
- What are the symptoms of deficiency of the various micronutrients in plants?
- What are the symptoms of toxicity in the various micronutrients in plants?
- How can micronutrients be supplied for major crop production?

Task Number 80

Diagnose nutrient deficiencies in plants.

Definition
Diagnosis should include identifying the physical symptoms that are the result of the nutrient deficiency.

Process/Skill Questions
- What are the foliar symptoms of a nutrient deficiency?
- What are the symptoms of nitrogen deficiency?
- What are the symptoms of phosphorus deficiency?
- What are the symptoms of potassium deficiency?
Task Number 81

Describe fertilizer application methods.

Definition
Description should include

- application in solid form
  - broadcasting
  - placement
  - localized placement
- application in liquid form
  - starter solution
  - fertigation
  - foliar application
  - direct application to soil/injection.

Process/Skill Questions

- When would one use a fertilizer application method?
- When would one use broadcast spreading of fertilizers?
- How does a fertilizer injector work?
- What is the composition of a slow-release fertilizer?
- What are some methods of fertilizing landscape plants?
- What are some methods of fertilizing bedding plants that are grown in the greenhouse?

Using Basic Scientific Principles in Plant Pest Management

Task Number 82

Identify the common invertebrates that affect plant growth and development.

Definition
Identification should include

- definition of an invertebrate
- listing different invertebrates
- beneficial vs. harmful/pest invertebrates in Virginia that have a significant effect on plant growth and development
- assessing injury based on mouth part
- anatomy and physiology of invertebrates
- beneficial and harmful/pest invertebrate life cycles.

Process/Skill Questions

- What are economic benefits and costs associated with invertebrate management?
- What are the major invertebrates that impact Virginia agriculture?
- What is a beneficial invertebrate?
• What are the basic body parts of an invertebrate?
• What are the life-developmental stages of invertebrates?
• Why is it important to understand the developmental stages of invertebrates when determining pest-control methods?

Task Number 83

Identify abiotic and biotic factors influencing plant growth and development.

Definition
Identification should include

• abiotic factors (noninfectious)
  o temperature
  o water
  o light
  o nutrients
  o pollutants
  o pH
  o chemical contaminants

• biotic factors (infectious)
  o eukaryotes
  o prokaryotes
  o parasitic higher plants
  o viruses/viroids
  o nematodes
  o protozoa.

Process/Skill Questions

• What are common plant viruses that affect Virginia agriculture?
• What are common plant fungal infections that affect Virginia agriculture?
• What are common plant bacterial infections that affect Virginia agriculture?
• What are the stages of plant disease development?
• What are some examples of abiotic disorders?

Task Number 84

Classify common weeds that affect plant growth.

Definition
Classification could include

• definition of a weed
• common weeds in Virginia
• broadleaf vs. grass weeds
• perennial, annual, and biennial weeds.

Process/Skill Questions

• What types of weeds impact Virginia agriculture?
• Which characteristics of weeds determine their classification?
• How do weeds affect plant growth?
• What are some methods of weed control?
• What are noxious weeds?

Task Number 85

Classify types of vertebrate pests that affect plant growth.

Definition
Classification should include mammals and birds.

Process/Skill Questions
• How are vertebrate pests managed?
• What symptoms indicate vertebrate pest damage to plants?
• What are the most common vertebrate pests found in Virginia?
• What is the economic impact of vertebrate pests on Virginia's agriculture industry?
• How does urban sprawl contribute to vertebrate pest problems?
• How should one manage vertebrate pests that are considered protected species?
• What agencies are responsible for wildlife management?

Task Number 86

Explain methods of plant pest management.

Definition
Explanation should include
• integrated pest management
• mechanical, biological, chemical, environmental, and cultural management
• economic threshold.

Process/Skill Questions
• What is integrated pest management?
• What are the different types of management methods?
• How do agriculturists decide which management method to use?
• What are some examples of biological management?
• What cultural methods are used in pest management?
• How does chemical overuse cause resistant populations of pests to develop?

Task Number 87

Interpret the information on a pesticide label.

Definition
Interpretation should include instructions on
• personal protective equipment (PPE) requirements
• ingredients— inert and active
• storage and disposal methods
• first-aid responses
• directions for use.
Process/Skill Questions

- What information should be on a pesticide label?
- What is an active ingredient?
- What personal precautions should one take when applying a pesticide?
- What are the signal words found on pesticide labels?
- What are the standard first-aid responses to pesticide exposure?

Task Number 88

Identify the application of different types of pesticides.

Definition
Identification should include

- fumigant
- formula-based types
  - emulsifiable concentrate
  - granular
  - dust
  - wettable powder
  - soluble powder
  - ready-to-use
- over-the-counter vs. restricted-use pesticides
- types of pesticide application equipment
- safety precautions for the various types of equipment.

Process/Skill Questions

- How do you determine which application method to use?
- What are the advantages and disadvantages of each application method?
- What is the role of the Environmental Protection Agency (EPA) and the Virginia Department of Agriculture and Consumer Services (VDACS) in determining which pesticides are labeled for a specific crop?
- What are the VDACS regulations for a license to apply pesticides?

Using Basic Scientific Skills and Principles in Plant Selection

Task Number 89

Identify U.S. Department of Agriculture (USDA) plant hardiness zones and how they affect plant selection.

Definition
Identification should include

- determining local zone(s)
- discussing the factors that create USDA hardiness zones
- reading a plant/seed tag to evaluate suitability for planting in a specific zone.
Process/Skill Questions

- What is a hardiness zone? What other factors need to be considered during plant selection?
- How does the plant hardiness zone assist one in plant selection and in determining what plants can grow in a specific area?

Task Number 90

Evaluate the common tree species of Virginia.

Definition
Evaluation should include

- identification of species
- classification of tree species (e.g., native, non-native, invasive, ornamental)
- growth requirements
- measurement of species
- overall uses
- economic impact.

Teacher resources:

- Forestry, Virginia FFA Organization
- FFA Guide, Virginia FFA Organization

Process/Skill Questions

- What are the major uses of trees grown in Virginia?
- What does each species require for optimal growth?
- How do management techniques vary for ornamental vs. commercial forest tree species?
- What are differences among native, non-native, and invasive tree species?

Task Number 91

Evaluate the common species of agronomic plants grown in Virginia.

Definition
Evaluation should include

- crops that are used for food, animal feed, fiber, and fuel
- identification of species
- growth requirements
- overall uses
- economic impact.

Teacher resources:

- Agronomy, Virginia FFA Organization
- 4-H and FFA Crops Judging Contest, Virginia FFA Organization
Process/Skill Questions

- What products are made from Virginia's agronomic crops?
- What is the economic impact of Virginia's agronomic crops?
- What are examples of agronomic crops specific to Virginia's physiographic regions?

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Task Number 92

Evaluate common species of fruits and vegetables grown in Virginia.

Definition
Evaluation should include

- identification of species
- growth requirements
- overall uses
- economic impact.

Process/Skill Questions

- What are some alternative market outlets for Virginia's fruits and vegetables?
- How has the economic impact of fruits and vegetables changed in recent years?
- What is the difference between a fruit and a vegetable?

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Task Number 93

Evaluate common species of nursery and landscape horticulture plants grown in Virginia.

Definition
Evaluation should include

- identification of species
- growth requirements
- overall uses
- economic impact.

Process/Skill Questions

- What are non-native plants, and when are they used?
- What environmental requirements are needed to grow common species of nursery/horticulture plants grown in Virginia?

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Task Number 94

Evaluate common species of turfgrass grown in Virginia.

Definition
Evaluation should include

- identification of species
• growth requirements
• overall uses
• economic impact.

Process/Skill Questions

• What are factors that determine turfgrass selection? Turf seed selection?
• How do mowing practices affect turf quality?
• What are common practices for turf establishment?
• What are the differences between warm- and cool-season grasses?
• What are examples of warm-season grasses? Cool-season grasses?

Task Number 95

Evaluate common species of floriculture crops grown in Virginia.

Definition
Evaluation should include

• identification of species
• growth requirements
• overall uses
• economic impact.

Process/Skill Questions

• What purpose do floriculture crops serve?
• What environmental requirements are needed to grow floriculture crops in Virginia?
• What specialized equipment is needed to grow floriculture crops in Virginia?

Incorporating Mechanical Skills Related to the Plant Systems Pathway

Task Number 96

Demonstrate safety practices and procedures in various areas associated with agricultural mechanics in plant systems.

Definition
Demonstrating safe practices and procedures must include

• passing written tests with 100 percent accuracy on
  o general lab/workshop safety
  o safety and operating procedures for all tools, equipment, and machinery
  o the major parts of all tools, equipment, and machinery
• passing a proficiency/performance test with 100 percent accuracy for all tools, equipment, and machinery
• following manufacturer instructions and reviewing safety manuals, when applicable
following all safety guidelines and procedures when using tools, equipment, and machinery in the agricultural mechanics laboratory or areas related to plant systems
selecting appropriate personal protective equipment (PPE) for the operation of concern
following the safety standards and regulations of the U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), the Equipment and Engine Training Council (EETC) Education Committee, and Safety Data Sheets (SDS).

Process/Skill Questions

- Why is it important to have every student achieve 100 percent on the state/local safety test?
- What are some examples of basic housekeeping standards?
- What is the appropriate procedure for selecting and using a fire extinguisher?
- What do the colors in the safety color-coding system indicate relative to the degree of hazard?
- What information should be sent with emergency responders to the hospital with the student if a chemical is splashed in an eye or wound?
- Are state and national safety standards followed in school labs/workshops? Explain.
- What agency requires labs/workshops and businesses to use the services of companies such as Safety Clean?
- What are the dangers of running an engine in a confined space without proper ventilation?
- Why is it important to achieve 100 percent accuracy on tests regarding safety and operating procedures before using tools, equipment, and machinery?

Task Number 97

Demonstrate equipment safety and operation as they relate to the plant systems pathway.

Definition
Demonstration should include

- using applicable PPE
- using language, symbols, and procedures related to the operation of equipment
- operating equipment following instructor and manufacturer specifications and guidelines
- identifying and using power tools and equipment following all safety procedures according to manufacturer specifications, using industry standards and instructor guidelines.

Process/Skill Questions

- Why are symbols used for the operation of equipment?
- Where can you find the safety rules for using the equipment at your school?

Task Number 98

Demonstrate standard measurement techniques in plant systems.

Definition
Demonstration may include
accurately reading a ruler with graduations in standard and metric units
calculating volume and area
using conversion factors (e.g., fractions to decimals, pints to quarts, feet to meters)
using calculations of basic decimals and fractions.

Process/Skill Questions

- What measurement techniques are frequently used in plant science?
- Why is it important to be able to use conversion factors?

Task Number 99

Demonstrate drawing for agricultural mechanics as it relates to the plant systems pathway.

Definition
Demonstration may include

- identifying and selecting equipment and supplies for drawing
- drawing views of objects and landscaping plans
- drawing a laboratory project plan
- exploring computer-aided design (CAD) programs.

Process/Skill Questions

- What views of objects can be drawn?
- What are the steps in drawing an object?
- What is the purpose of a project plan?
- What CAD programs are used in the plant systems career pathway?
- What are the advantages of using CAD programs?

Task Number 100

Examine metalworking operations as they relate to the plant systems pathway.

Definition
Examination may include

- identifying and using tools and equipment, following all safety procedures according to manufacturer specifications, using industry standards and instructor guidelines
- identifying applicable PPE
- identifying metals by physical properties
- identifying metalworking tools, equipment, and supplies
- identifying the processes involved in changing the physical property of metals
- identifying and selecting tools, equipment, and supplies for tool fitting
- reconditioning an agricultural mechanics tool
- identifying arc and gas welding tools, equipment, and supplies
- using the arc and gas welding equipment following all safety procedures, using industry standards and instructor guidelines
- explaining the procedures for down-hand welding
- estimating a bill of materials
• constructing an approved metalworking project using all safety procedures, following industry standards and instructor guidelines
• preparing and applying a finish following all safety procedures, using industry standards and instructor guidelines.

Process/Skill Questions

• How is metalworking used in agriculture?
• What safety measures must be taken when working with metals?
• What steps are involved in changing the physical property of metals?
• What are the appropriate procedures for each application of tool fitting?
• What are the steps involved in reconditioning an agricultural mechanics tool?
• Why is tool reconditioning important?
• What safety precautions should be taken when arc welding?
• What steps should be followed when arc welding?
• What safety precautions should be taken when gas welding?
• What is the procedure for correctly performing down-hand welding?
• What steps are involved in constructing a metalworking project?

Task Number 101

Examine woodworking operations as they relate to the plant systems pathway.

Definition
Examination may include

• identifying all applicable PPE
• identifying and using hand tools, power tools, woodworking tools, and supplies following all safety procedures according to manufacturer specifications, using industry standards and instructor guidelines
• selecting and using wood fasteners estimating a bill of materials
• constructing an agricultural woodworking project, using hand tools, power tools, using all safety procedures, following industry standards and instructor guidelines
• preparing and applying finishes, using all safety procedures, following industry standards and instructor guidelines.

Process/Skill Questions

• What safety precautions apply to the use of hand tools and power tools? Woodworking tools?
• What types of wood fasteners are available?
• What are the steps in estimating a bill of materials?
• What is the purpose of a bill of materials in project planning?
• What are the steps in constructing a woodworking project?

Task Number 102

Examine electrical operations as they relate to the plant systems pathway.

Definition
Examination may include
• identifying all applicable PPE
• explaining the principles, language, and symbols of electricity
• using tools and equipment related to electricity, using all safety procedures, following industry standards and instructor guidelines
• using calculations related to electricity
• constructing an approved electrical project, using all safety procedures, following industry standards and instructor guidelines.

Process/Skill Questions

• What are the tools used in electrical work?
• What electricity projects would relate to the plant industry?
• How are watts, volts, and amperes calculated?
• What is Ohm’s law?
• How does Ohm’s law apply to electricity?
• What is the proper depth to bury underground cable?
• What class of wire or cable should be used for underground use?
• Why is contacting Virginia811.com essential before excavating?

Task Number 103

Examine small-engine operations as they relate to the plant systems pathway.

Definition
Examination may include

• identifying all applicable PPE
• explaining the principles, language, and theory of small engines
• explaining the safety measures and procedures that should be followed and the PPE that should be used when repairing small engines
• using tools and equipment related to small engines, using all safety procedures, following industry standards and instructor guidelines
• completing an approved small-engine project (e.g., troubleshooting, maintaining, servicing) using all safety procedures, following industry standards and instructor guidelines.

Process/Skill Questions

• What are the symbols used in small-engine work?
• What are the tools used in small-engine work?
• What small-engine projects would relate to the plant systems pathway?
• Why is an annual engine maintenance program important?

Task Number 104

Examine plumbing operations as they relate to the plant systems pathway.

Definition
Examination may include

• explaining the principles, language, and symbols of plumbing
explaining the safety measures that should be followed when conducting plumbing operations
using tools and equipment related to plumbing, using all safety procedures, following industry standards and instructor guidelines
using calculations related to plumbing
completing an approved plumbing project, using tools and equipment related to plumbing using all safety procedures, following industry standards and instructor guidelines.

Process/Skill Questions

- What are the tools used in plumbing work?
- What plumbing projects would relate to the plant systems pathway?

**SOL Correlation by Task Table**

<table>
<thead>
<tr>
<th>Task</th>
<th>SOL Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploring Leadership Opportunities through FFA</td>
<td></td>
</tr>
<tr>
<td>39 Identify the role of supervised agricultural experiences (SAEs) in agricultural education.</td>
<td>English: 9.3, 9.5, 10.3, 10.5</td>
</tr>
<tr>
<td>40 Participate in an SAE.</td>
<td>English: 9.5, 9.8, 10.5, 10.8</td>
</tr>
<tr>
<td>41 Identify the benefits and responsibilities of FFA membership.</td>
<td>English: 9.5, 9.6, 9.7, 9.8, 10.5, 10.6, 10.7, 10.8</td>
</tr>
<tr>
<td>42 Describe leadership characteristics and opportunities as they relate to agriculture and FFA.</td>
<td>English: 9.5, 10.5 History and Social Science: VUS.8, VUS.9, VUS.10, VUS.11, WHII.8, WHII.10, WHII.11</td>
</tr>
<tr>
<td>43 Apply for an FFA degree and/or an agricultural proficiency award.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>44 Explain the characteristics of plants.</td>
<td>English: 9.5, 10.5 History and Social Science: WG.2 Science: BIO.4c</td>
</tr>
<tr>
<td>Introducing Botany</td>
<td></td>
</tr>
<tr>
<td>44 Explain the importance of plant taxonomy.</td>
<td>English: 9.5, 10.5 Science: BIO.4, BIO.6</td>
</tr>
<tr>
<td>45 Identify major plant parts and their primary functions.</td>
<td>Science: BIO.4</td>
</tr>
<tr>
<td>46 Explain the characteristics of plants.</td>
<td>Science: BIO.4, BIO.6</td>
</tr>
<tr>
<td>47 Differentiate between plant life cycles based on classification.</td>
<td>English: 9.5, 10.5 Science: BIO.4</td>
</tr>
<tr>
<td>48 Describe the growth stages of a plant.</td>
<td>English: 9.5, 10.5 Science: BIO.4</td>
</tr>
<tr>
<td>49 Illustrate the importance of plant systems in relation to humans.</td>
<td>History: WG 17, WHII 14, VUS 14, Govt 9, 12, 14, 15 Science: BIO.8</td>
</tr>
<tr>
<td>50 Discuss the major disciplinary fields of plant agriculture.</td>
<td>English: 9.1, 10.1 Science: BIO.1, BIO.5</td>
</tr>
<tr>
<td>51 Research innovative plant breeding technologies.</td>
<td>English: 9.8, 10.8</td>
</tr>
<tr>
<td>Task</td>
<td>SOL Correlations</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Understanding Plant Processes</strong></td>
<td>History: WG 17, WHII 14, VUS 14, Govt 9, 12, 14, 15</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td>BIO.5</td>
</tr>
<tr>
<td>52 Explain the life-sustaining processes by which all plants grow and develop.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.2</td>
</tr>
<tr>
<td>53 Explain the process of osmosis.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.3</td>
</tr>
<tr>
<td>54 Explain the process of diffusion.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.3</td>
</tr>
<tr>
<td><strong>Evaluating the Environmental Stimuli that Affect Plant Growth and Development</strong></td>
<td>History: WG 17, WHII 14, VUS 14, Govt 9, 12, 14, 15</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td>BIO.1, BIO.2</td>
</tr>
<tr>
<td>55 Evaluate the effect of light on plants.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.1, BIO.2</td>
</tr>
<tr>
<td>56 Evaluate the effect of temperature on plants.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>History: WG 17, WHII 14, VUS 14</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.1, BIO.2</td>
</tr>
<tr>
<td>57 Evaluate the effect of water on plants.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>History: WG 17, WHII 14, VUS 14</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.1, BIO.2</td>
</tr>
<tr>
<td>58 Evaluate the effect of carbon dioxide (CO₂), oxygen, and airflow on plants.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>History: WG 17, WHII 14, VUS 14, Govt 9, 12, 14, 15</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.1, BIO.2</td>
</tr>
<tr>
<td>59 Evaluate types and components of greenhouses and other indoor plant-growing facilities.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td><strong>Demonstrating Sexual Propagation in the Production of Plants</strong></td>
<td>History: WG 17, WHII 14, VUS 14</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td>BIO.5</td>
</tr>
<tr>
<td>60 Examine the advantages and disadvantages of sexual propagation in the development of new plant varieties.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.5</td>
</tr>
<tr>
<td>61 Plant seeds using various methods.</td>
<td></td>
</tr>
<tr>
<td>62 Analyze scarification and stratification methods that aid in the propagation process.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>63 Describe the germination process.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>64 Calculate the germination rates of seeds.</td>
<td></td>
</tr>
<tr>
<td>65 Demonstrate how to transplant seedlings.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td><strong>Demonstrating Methods of Asexual Propagation in the Production of Plants</strong></td>
<td>History: WG 17, WHII 14, VUS 14</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td>BIO.5</td>
</tr>
<tr>
<td>66 Examine the advantages and disadvantages of asexual propagation in the production of plants.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td></td>
<td>Science: BIO.5</td>
</tr>
<tr>
<td>67 Demonstrate how to produce plants through cuttings.</td>
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</tr>
<tr>
<td>68 Demonstrate how to produce plants by layering.</td>
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</tr>
<tr>
<td>69 Demonstrate how to produce plants through division and separation.</td>
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</tr>
<tr>
<td>70 Describe grafting and budding techniques for woody and herbaceous plants.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Task</td>
<td>SOL Correlations</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td><strong>71</strong></td>
<td>Describe how to produce plants through micropropagation.</td>
</tr>
</tbody>
</table>
| **72** | Evaluate cultural practices for vegetable crops grown in a greenhouse. | English: 9.5, 10.5  
History: WG 17, WHII 14, VUS 14, Govt 9, 12, 14, 15 |
| **Managing Plants: Soil and Soilless Growing Systems** | | |
| **73** | Evaluate the physical and chemical properties of soil and soilless substrates. | English: 9.5, 10.5 |
| | Science: ES.8 |
| **74** | Amend substrates for optimal plant growth. | English: 9.5, 10.5 |
| **75** | Collect a soil sample for evaluation. | English: 9.5, 10.5 |
| | Science: ES.8 |
| **76** | Analyze soil sample for nutrients and pH. | English: 9.5, 10.5 |
| | Science: ES.8 |
| **77** | Describe hydroponic, aquaponic, and aeroponic plant production. | English: 9.5, 10.5 |
| **Investigating the Principles of Plant Nutrition** | | |
| **78** | Evaluate the effects of primary and secondary macronutrients on plant growth and development. | English: 9.5, 10.5 |
| | Science: BIO.2 |
| **79** | Evaluate the effects of micronutrients on plant growth and development. | English: 9.5, 10.5 |
| | Science: BIO.2 |
| **80** | Diagnose nutrient deficiencies in plants. | English: 9.5, 10.5 |
| **81** | Describe fertilizer application methods. | English: 9.5, 10.5 |
| **Using Basic Scientific Principles in Plant Pest Management** | | |
| **82** | Identify the common invertebrates that affect plant growth and development. | English: 9.3, 9.5, 10.3, 10.5 |
| | Science: BIO.4, BIO.8 |
| **83** | Identify abiotic and biotic factors influencing plant growth and development. | English: 9.5, 10.5 |
| | Science: BIO.4, BIO.8 |
| **84** | Classify common weeds that affect plant growth. | English: 9.3, 9.5, 10.3, 10.5 |
| | Science: BIO.4, BIO.8 |
| **85** | Classify types of vertebrate pests that affect plant growth. | English: 9.5, 10.5 |
| | Science: BIO.4, BIO.8 |
| **86** | Explain methods of plant pest management. | English: 9.5, 10.5 |
| **87** | Interpret the information on a pesticide label. | English: 9.5, 10.5 |
| **88** | Identify the application of different types of pesticides. | English: 9.5, 10.5 |
| **Using Basic Scientific Skills and Principles in Plant Selection** | | |
| **89** | Identify U.S. Department of Agriculture (USDA) plant hardiness zones and how they affect plant selection. | English: 9.5, 10.5 |
| | History: Govt 7, 8, 9, 12, 14, 15 |
| **90** | Evaluate the common tree species of Virginia. | English: 9.5, 10.5 |
| | History: Govt 7, 8, 9, 12, 14, 15  
Science: BIO.4, BIO.8 |
<p>| <strong>91</strong> | Evaluate the common species of agronomic plants grown in Virginia. | English: 9.5, 10.5 |</p>
<table>
<thead>
<tr>
<th>Task</th>
<th>SOL Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate common species of fruits and vegetables grown in Virginia.</td>
<td>History: Govt 7, 8, 9, 12, 14, 15 Science: BIO.6, BIO.8</td>
</tr>
<tr>
<td>Evaluate common species of nursery and landscape horticulture plants grown in Virginia.</td>
<td>History: Govt 7, 8, 9, 12, 14, 15 Science: BIO.6, BIO.8</td>
</tr>
<tr>
<td>Evaluate common species of turfgrass grown in Virginia.</td>
<td>History: Govt 7, 8, 9, 12, 14, 15 Science: BIO.6, BIO.8</td>
</tr>
<tr>
<td>Evaluate common species of floriculture crops grown in Virginia.</td>
<td>History: Govt 7, 8, 9, 12, 14, 15 Science: BIO.6, BIO.8</td>
</tr>
<tr>
<td><strong>Incorporating Mechanical Skills Related to the Plant Systems Pathway</strong></td>
<td></td>
</tr>
<tr>
<td>Demonstrate safety practices and procedures in various areas associated with agricultural mechanics in plant systems.</td>
<td>History: Govt 7, 8, 9, 12, 14, 15 Science: CH.1</td>
</tr>
<tr>
<td>Demonstrate equipment safety and operation as they relate to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Demonstrate standard measurement techniques in plant systems.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Mathematics: A.1, A.4 Science: ES.1</td>
<td></td>
</tr>
<tr>
<td>Demonstrate drawing for agricultural mechanics as it relates to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Mathematics: G.14</td>
<td></td>
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<tr>
<td>Examine metalworking operations as they relate to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Examine woodworking operations as they relate to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Examine electrical operations as they relate to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Mathematics: A.1, A.4 Science: PH.11</td>
<td></td>
</tr>
<tr>
<td>Examine small-engine operations as they relate to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
<tr>
<td>Examine plumbing operations as they relate to the plant systems pathway.</td>
<td>English: 9.5, 10.5</td>
</tr>
</tbody>
</table>

### FFA Information

The National FFA is an organization dedicated to preparing members for leadership and careers in the science, business, and technology of agriculture. Local, state, and national activities and
award programs provide opportunities to apply knowledge and skills acquired through agriculture education.

For additional information about the student organization, see the National FFA website and the Virginia FFA Association website.

The following leadership development events are available for this course:

- Agricultural Issues
- Conduct of Chapter Meetings
- Creed Speaking
- Employment Skills
- Extemporaneous Public Speaking
- Parliamentary Procedure
- Prepared Public Speaking

The following career development events are available for this course:

- Agricultural Technology and Mechanical Systems
- Agronomy
- Floriculture
- Forestry
- Nursery/Landscape

**Entrepreneurship Infusion Units**

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”
Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Agricultural Biotechnology Assessment
- BASF Plant Science Certification Examination
- College and Work Readiness Assessment (CWRA+)
- Customer Service Specialist (CSS) Examination
- Floriculture: Greenhouse Assessment
- Horticulture-Landscaping Assessment
- National Career Readiness Certificate Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.

- Agricultural Business Fundamentals I (8022/36 weeks)
- Agricultural Production Technology (8010/36 weeks)
- Applied Agricultural Concepts (8072/18 weeks)
- Applied Agricultural Concepts (8073/36 weeks)
- Biological Applications in Agriculture (8086/36 weeks)
- Ecology and Environmental Management (8045/18 weeks)
- Ecology and Environmental Management (8046/36 weeks)
- Floral Design I (8055/36 weeks)
- Floral Design II (8056/36 weeks)
- Floriculture (8038/36 weeks)
- Forestry Management (8042/36 weeks)
- Foundations of Agriculture, Food, and Natural Resources (8006/36 weeks)
- Greenhouse Plant Production and Management (8035/36 weeks)
- Horticulture Sciences (8034/36 weeks)
- Landscaping I (8036/36 weeks)
- Livestock Production Management (8012/36 weeks)
- Operating the Farm Business (8014/36 weeks)
- Turfgrass Management (8051/36 weeks)
- Introduction to Natural Resources & Ecology Systems (8040/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agribusiness Systems</td>
<td>Agricultural Commodity Broker</td>
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<tr>
<td></td>
<td>Agricultural Economist</td>
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<td></td>
<td>Agricultural Loan Officer</td>
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<td>Agricultural Products Sales Representative</td>
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<td></td>
<td>Farm Products Purchasing Agent and Buyer</td>
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<td></td>
<td>Farm, Ranch Manager</td>
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<tr>
<td></td>
<td>Farmer/Rancher</td>
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<tr>
<td></td>
<td>Feed, Farm Supply Store Sales Manager</td>
</tr>
<tr>
<td></td>
<td>Sales Manager</td>
</tr>
<tr>
<td>Environmental Service Systems</td>
<td>Agricultural Products Sales Representative</td>
</tr>
<tr>
<td></td>
<td>Environmental Compliance Inspector</td>
</tr>
<tr>
<td></td>
<td>Environmental Sampling and Analysis Technician</td>
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</tbody>
</table>

41
<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
</table>
| Career Cluster: Agriculture, Food and Natural Resources | Hazardous Materials Handler  
Secondary School Teacher  
Toxicologist  
Turf Farmer  
Water Conservationist |
| Food Products and Processing Systems       | Biochemist  
Food Scientist |
| Natural Resources Systems                  | Ecologist  
Forest Manager, Forester  
Forest Technician  
Microbiologist  
Outdoor Recreation Guide  
Park Manager  
Park Technician  
Range Technician  
Wildlife Manager |
| Plant Systems                              | Agricultural Products Sales Representative  
Botanist  
Certified Crop Advisor  
Crop Grower  
Custom Harvester  
Farm, Ranch Manager  
Farmer/Rancher  
Floral Designer  
Floral Shop Manager  
Forest Geneticist  
Golf Course Superintendent  
Nursery and Greenhouse Manager  
Ornamental Horticulturist  
Plant Breeder/ Geneticist  
Secondary School Teacher  
Soil and Plant Scientist  
Tree Surgeon  
Turf Farmer |
| Power, Structural, and Technical Systems   | Agricultural Engineer  
Agricultural Equipment Parts Manager  
Agricultural Equipment Parts Salesperson |