

Horticulture CTAG Alignment

This document contains information about five (5) Career-Technical Articulation Numbers (CTANs) for the Horticulture Career-Technical Assurance Guide (CTAG). The CTANs are:

1. Floral Design and Marketing
2. Landscape Maintenance
3. Equipment Operation and Maintenance
4. Plant and Horticulture Science
5. Turf-grass Management

1. Floral Design and Marketing: CTAN alignment with the Horticulture Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

General Course Description: Students will develop skills in floral design. Basic floral design elements and principles as well as the tools, equipment, and plant materials used in floral design will be emphasized. Holiday, wedding, funeral and other specialty designs will be created.

Advising Notes:

- Students must access credit within 3 years of program completion

Semester Credit Hours: 3.0

Alignment:

Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.

Learning Outcomes The student will be able to:	Outcomes and Competencies from the Horticulture Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards
1. Identify and use floral tools, equipment, and supplies safely and correctly.*	<p>Outcome 1.12 Site and Personal Safety Procedures</p> <p>1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.</p> <p>1.12.2. Interpret safety signs and symbols.</p> <p>1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.</p> <p>1.12.8. Identify safety hazards and take corrective measures.</p> <p>1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.</p> <p>Outcome 4.2 Equipment Operation</p> <p>4.2.2. Differentiate among the functions, limitations, and proper use of equipment, equipment controls, and instrumentation.</p>

	4.2.5. Select and operate the equipment and attachments needed to complete the task including levers, pedals or valves.
2. Demonstrate proper techniques to condition handle and store fresh flowers and foliage.*	<p>Outcome 8.5 Harvesting</p> <p>8.5.1. Identify characteristics of grains, seeds, vegetables, fruits and ornamental plants that indicate crop maturity.</p> <p>8.5.2. Describe safety precautions to take when harvesting.</p> <p>8.5.6. Evaluate the impact of harvest techniques on the quality of plants and plant products.</p> <p>8.5.8. Assess the stage of growth to determine maturity and salability of grains, seeds, vegetables, fruits and ornamental plants.</p> <p>8.5.11. Evaluate crop yield and loss data.</p> <p>8.5.12. Implement management practices to reduce loss.</p>
3. Create basic designs including round, triangular, straight line, and curved line variations.*	<p>Outcome 5.3 Design and Estimate</p> <p>5.3.5. Apply the principles of balance, proportion, scale, focal point, emphasis, rhythm, harmony, and unity to create a design.</p> <p>5.3.6. Apply the elements of line, function, form, texture, and color to create a design.</p> <p>5.3.7. Incorporate design, organizational and spatial principles into a design.</p> <p>5.3.13. Establish the sequential steps of construction and installation</p>
4. Design various seasonal, theme, wedding, sympathy, novelty, and corsage designs.*	<p>Outcome 5.3 Design and Estimate</p> <p>5.3.5. Apply the principles of balance, proportion, scale, focal point, emphasis, rhythm, harmony, and unity to create a design.</p> <p>5.3.6. Apply the elements of line, function, form, texture and color to create a design.</p> <p>5.3.7. Incorporate design, organizational and spatial principles into a design.</p> <p>5.3.13. Establish the sequential steps of construction and installation.</p>
5. Create a profitable floral design based on customer need.*	<p>Outcome 1.2 Leadership and Communications</p> <p>1.2.2. Deliver formal and informal presentations.</p> <p>1.2.3. Identify and use verbal, nonverbal, and active listening skills to communicate effectively.</p> <p>1.2.4. Use negotiation and conflict-resolution skills to reach solutions.</p>

	<p>Outcome 1.6 Business Literacy</p> <p>1.6.1. Identify business opportunities.</p> <p>1.6.6. Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry.</p> <p>1.6.7. Identify the effect of supply and demand on products and services.</p> <p>Outcome 1.10 Sales and Marketing</p> <p>1.10.2. Determine the customer's needs and identify solutions.</p> <p>1.10.5. Monitor customer expectations and determine product/service satisfaction by using measurement tools.</p>
<p>6. Manage inventory based on budgeting and sales forecasting.*</p>	<p>Outcome 1.8 Operations Management</p> <p>1.8.1. Forecast future resources and budgetary needs using financial documents (e.g., balance sheet, demand forecasting, financial ratios).</p> <p>1.8.5. Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN).</p> <p>1.8.6. Identify the advantages and disadvantages of carrying cost and Just-in-Time (JIT) production systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability.</p> <p>1.8.7. Collect information and feedback to help assess the organization's strategic planning and policymaking processes.</p> <p>1.8.9. Develop a budget that reflects the strategies and goals of the organization.</p>

2. Landscape Maintenance: CTAN alignment with the Horticulture Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

General Course Description: Principles and practices of landscape maintenance are examined and implemented. Included are proper pruning, planting, preparation mulching, fertilizing, water management and soil preparation.

Advising Notes:

Student must access credit within 3 years of program completion.

Semester Credit Hours: 3.0

Alignment:

Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.

Learning Outcomes The student will be able to:	Outcomes and Competencies from the Horticulture Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards
<p>1. Analyze landscape sites for development of a maintenance program.*</p>	<p>Outcome 5.3 Design and Estimate</p> <p>5.3.1. Identify, interpret and use symbols, lines, dimensions, views, sections, site plans, floor plans, specifications, common scales, detail drawings and abbreviations on drawings and prints.</p> <p>5.3.3. Complete a site inventory and analysis including physical conditions, code and utilities requirements, and environmental impact.</p> <p>5.3.4. Develop a program list, including intended use, budget, economics, customer wants and needs and maintenance.</p> <p>5.3.8. Calculate the space requirements and compute various attributes, including length, angle measurement, surface area and volume.</p> <p>5.3.9. Prepare sketches, drawings, prints, specifications and construction details</p> <p>Outcome 5.4 Surveying and Mapping</p> <p>5.4.3. Perform site measurements.</p> <p>Outcome 8.4 Growth and Management</p> <p>8.4.2. Identify plant anatomical structures and tissues.</p>
<p>2 Describe, calculate amounts, and correctly apply a variety of mulches.*</p>	<p>Outcome 8.4 Growth and Management</p> <p>8.4.9. Manipulate natural and artificial factors to influence plant germination, growth, and development.</p>
<p>3. Assess the pruning needs of a woody plant.*</p>	<p>Outcome 8.4 Growth and Management</p> <p>8.4.14. Control plant growth through mechanical and chemical means.</p>

<p>4. Describe and demonstrate proper pruning techniques.*</p>	<p>Outcome 8.4 Growth and Management 8.4.14. Control plant growth through mechanical and chemical means.</p>
<p>5. Describe and demonstrate proper planting techniques.*</p>	<p>Outcome 8.4 Growth and Management 8.4.13. Evaluate and implement transplanting practices.</p>
<p>6. Evaluate and prepare soil for planting landscape plants.*</p>	<p>Outcome 6.1 Soils 6.1.2. Describe the relationship among physical properties of soils. 6.1.5. Determine land use and identify land capabilities classes. Outcome 8.4 Growth and Management 8.4.10. Select, evaluate, and prepare soil or media for planting.</p>
<p>7. Describe proper water management practices used in the landscape.*</p>	<p>Outcome 8.4 Growth and Management 8.4.14. Analyze plant water requirements and provide water through artificial or natural means</p>
<p>8. Describe and demonstrate fertilization application techniques and practices.*</p>	<p>Outcome 8.1 Plant Nutrition 8.1.8. Calculate nutrient requirements and select nutrient sources and additives for optimum economic return. 8.1.9. Determine the nutrient content of organic and inorganic fertilizers. 8.1.10 Select the methods, time nutrient application, and apply nutrients.</p>
<p>9. Demonstrate safe and correct use of large and small hand/power equipment (e.g., shears, shovels, power trimmers/blowers, riding and walk behind mowers, skid steer loaders, truck and trailers, etc.)*</p>	<p>Outcome 1.12 Site and Personal Safety Procedures 1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling. 1.12.2. Interpret safety signs and symbols. 1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials. 1.12.8. Identify safety hazards and take corrective measures. 1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.</p>

		<p>Outcome 4.2 Equipment Operations</p> <p>4.2.1. Follow manufacturer's recommended operating procedures and adjustment specifications.</p> <p>4.2.2. Differentiate the functions, limitations and proper use of equipment, equipment controls and instrumentation.</p> <p>4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.</p> <p>4.2.4. Perform appropriate start-up, operating and shut-down procedures.</p> <p>4.2.5. Select and operate the equipment and attachments needed to complete the task including levers, pedals or valves.</p>	
	<p>10. Develop a landscape maintenance schedule.*</p>	<p>Outcome 8.1 Plant Nutrition</p> <p>8.1.10. Select the methods, time of nutrient application, and apply nutrients.</p> <p>Outcome 8.3 Pest Management</p> <p>8.3.9. Develop an IPM plan, based on pest life cycles, available treatments, application methods and the impact on the environment</p> <p>Outcome 8.4 Growth and Management</p> <p>8.4.8. Understand the influence of environmental factors on plant growth, development, and maintenance.</p> <p>8.4.14. Control plant growth through mechanical and chemical means.</p>	
	<p>11. Determine landscape maintenance practices according to specific ecosystems characteristics.*</p>	<p>Outcome 6.1 Ecosystems</p> <p>6.10.3. Identify and classify interactions among organisms, including predation, symbiosis and competition to determine a species interdependent relationships.</p> <p>6.10.5. Connect biotic interactions with the abiotic environment.</p> <p>6.10.8. Select and implement restoration ecology practices to repair damaged ecosystems.</p>	

3. Equipment Operation and Maintenance: CTAN alignment with the Horticulture Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

General Course Description: Students will learn the selection, operation, and maintenance of green industry equipment. Small engine operation, troubleshooting, and overhaul are included along with development of maintenance schedules.

Advising Notes:

Students must access credit within 3 years of program completion.

Semester Credit Hours: 3.0

Alignment:

Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.

Learning Outcomes The student will be able to:	Outcomes and Competencies from the Horticulture Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards
<p>1. Demonstrate safety rules and regulations.*</p>	<p>Outcome 1.12 Site and Personal Safety Procedures</p> <p>1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.</p> <p>1.12.2. Interpret safety signs and symbols.</p> <p>1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.</p> <p>1.12.8. Identify safety hazards and take corrective measures.</p> <p>1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.</p>
<p>2. Understand the principles of operation of different type of engines/power sources, and power transfer systems commonly associated with landscape equipment.*</p>	<p>Outcome 4.3 Engines</p> <p>4.3.1. Assess the physical and mechanical principles of engine operation, including motion, friction, and thermodynamics.</p> <p>4.3.2. Retrieve and record stored on-board diagnostics (OBD) trouble codes and clear codes where applicable.</p> <p>4.3.3. Locate the nameplate and determine engine specifications.</p> <p>4.3.4. Analyze, evaluate, and troubleshoot an engine.</p> <p>4.3.5. Compare and contrast two-cycle and four-cycle engines and their operating principles.</p>

	<p>4.3.6. Evaluate engine head and engine block components to determine serviceability according to the manufacturer's specifications.</p> <p>4.3.8. Employ the requirements for engine servicing to maintain emission requirements.</p> <p>Outcome 4.4 Lubricants and Cooling Systems</p> <p>4.4.1. Explain principles of engine lubrication and cooling.</p> <p>4.4.2. Perform lubrication, cooling system and pressure and sensor tests.</p> <p>4.4.7. Test, drain, flush and refill coolant and bleed the cooling system.</p> <p>Outcome 4.7 Transmission of Power</p> <p>4.7.1. Describe the features, benefits, and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).</p> <p>4.7.2. Describe the physical and mechanical principles of mechanical, hydraulic, pneumatic, and electrical power transfer.</p>
<p>3. Demonstrate proper troubleshooting procedures for green industry equipment*</p>	<p>Outcome 4.1 Tools, Stationary, and Mobile Equipment Maintenance</p> <p>4.1.1. Identify the types of hand tools, power tools, and stationary equipment and describe their function.</p> <p>4.1.2. Ensure the presence and functionality of safety systems and hardware.</p> <p>4.1.3. Identify potential hazards and limitations related to the use of hand tools, power tools, and stationary equipment.</p> <p>4.1.4. Maintain machinery, equipment, instrument and facility cleanliness, appearance and safety.</p> <p>4.1.5. Inspect and service the electrical connections and lamps.</p> <p>4.1.6. Inspect for fluid leakage, fluid levels, and condition of fluids.</p> <p>4.1.7. Clean, lubricate and adjust machinery and equipment.</p> <p>4.1.8. Select fluids, maintain fluid levels, and replace system filters.</p> <p>4.1.9. Inspect and maintain fluid conveyance and storage components (e.g., hoses and lines, valves, nozzles).</p> <p>4.1.10. Inspect and replace drive belts.</p> <p>4.1.11. Calibrate metering, monitoring, and sensing equipment.</p>

<p>4. Operate according to the manufacturer specification within operators manual, a variety of industry standard large and small landscape equipment, including; skid loaders, compact utility loaders, trucks and trailers, and zero turn mowers.*</p>	<p>Outcome 4.2 Equipment Operations</p> <p>4.2.1. Follow manufacturer's recommended operating procedures and adjustment specifications.</p> <p>4.2.2. Differentiate the functions, limitations, and proper use of equipment, equipment controls, and instrumentation.</p> <p>4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.</p> <p>4.2.4. Perform appropriate start-up, operating and shutdown procedures.</p> <p>4.2.5. Select and operate the equipment and attachments needed to complete the task including levers, pedals, or valves.</p>
<p>5. Develop equipment maintenance schedules.*</p>	<p>Outcome 4.1 Tools, Stationary, and Mobile Equipment Maintenance</p> <p>4.1.1. Identify the types of hand tools, power tools, and stationary equipment and describe their function.</p> <p>4.1.2. Ensure the presence and functionality of safety systems and hardware.</p> <p>4.1.3. Identify potential hazards and limitations related to the use of hand tools, power tools, and stationary equipment.</p> <p>4.1.4. Maintain machinery, equipment, instrument and facility cleanliness, appearance and safety.</p> <p>4.1.5. Inspect and service the electrical connections and lamps.</p> <p>4.1.6. Inspect for fluid leakage, fluid levels and the condition of fluids.</p> <p>4.1.7. Clean, lubricate and adjust machinery and equipment.</p> <p>4.1.8. Select fluids, maintain fluid levels and replace system filters.</p> <p>4.1.9. Inspect and maintain fluid conveyance and storage components (e.g., hoses and lines, valves, nozzles).</p> <p>4.1.10. Inspect and replace drive belts.</p> <p>4.1.11. Calibrate metering, monitoring, and sensing equipment.</p> <p>Outcome 4.3 Engines</p> <p>4.3.4. Analyze, evaluate and troubleshoot an engine.</p> <p>4.3.8. Employ the requirements for engine servicing to maintain emission requirements.</p> <p>Outcome 4.4 Lubrication and Cooling Systems</p> <p>4.4.1. Explain principles of engine lubrication and cooling.</p>

4. Plant and Horticulture Science: CTAN alignment with the Horticulture Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education

General Course Description: This course focuses on skills and technologies essential for horticultural plant production. Cultural and sustainable production practices will be examined. Students will apply scientific knowledge of plant development, nutrition, and growth regulation. Environmental aspects of irrigation, chemical application, and soil conservation will be evaluated.

Advising Notes:

Must access credit within 3 years of program completion

Semester Credit Hours: 3.0 Alignment:

Asterisked Learning Outcomes are considered essential in the postsecondary curriculum

Learning Outcomes The student will be able to:	Outcomes and Competencies from the Horticulture Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards
1. Students will be able to identify plant anatomical structures and describe their physiological functions.*	Outcome 8.4 Growth and Management 8.4.2. Identify plant anatomical structures and tissues. 8.4.4. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis. 8.4.5. Understand aerobic respiration and its relationship to plant growth and management. 8.4.16 Explain the process and importance of transpiration in plant growth and development.
2. Students will be able to identify and classify plants by taxonomy at different stages of growth.*	Outcome 8.2 Plant Reproduction 8.2.3. Compare and contrast variations of plant reproductive systems among plant species. Outcome 8.4 Growth and Management 8.4.1. Identify and classify plants using taxonomy. 8.4.2. Identify plant anatomical structures and tissues. 8.4.3. Identify and classify seeds and plants at all stages of growth.
3. Students will compare and contrast sexual and asexual reproduction, and apply basic methods for propagating plants.*	Outcome 8.2 Plant Reproduction 8.2.1. Identify the reproductive anatomy of plants and describe their physiological functions. 8.2.2. Describe how biotic and abiotic factors (e.g. Insects, light, temperature, microorganisms, moisture, and location) influence and optimize plant reproduction.

		<p>8.2.3. Compare and contrast variations of plant reproductive systems among plant species.</p> <p>8.2.4. Select seeds and seed stock for desired traits.</p> <p>8.2.5. Select and apply methods that create desired traits in seeds.</p> <p>8.2.6. Select and apply all methods of asexual plant propagation for desired traits (e.g., grafting, layering, cutting, cloning).</p>
	<p>4. Students will understand basic plant nutrition and identify the causes and symptoms of nutrient deficiencies, and select methods of supplementing the required nutrients.*</p>	<p>Outcome 8.1 Plant Nutrition</p> <p>8.1.1. Compare and contrast organic and inorganic sources of macronutrients and micronutrients.</p> <p>8.1.2. Describe the functions of macronutrients and micronutrients in plants and the role that microorganisms play in plant nutrition.</p> <p>8.1.3. Determine nutrient requirements of plants.</p> <p>8.1.4. Identify symptoms and causes of plant nutrient deficiencies and toxicities.</p> <p>8.1.5. Collect soil and plant tissue for testing and analysis.</p> <p>8.1.6. Analyze and draw conclusions from soil and plant tissue test data.</p> <p>8.1.7. Distinguish between biotic and abiotic factors (e.g. minerals, pH, microorganisms) that influence and optimize the availability of nutrients for plants.</p> <p>8.1.8. Calculate nutrient requirements and select nutrient sources and additives for optimum economic return.</p> <p>8.1.9. Determine the nutrient content of organic and inorganic fertilizers.</p> <p>8.1.10. Select the methods and time of nutrient application apply nutrients.</p>
	<p>5. Students will determine optimum management practices for plant growth.*</p>	<p>Outcome 6.2 Water</p> <p>6.2.1. Assess and explain the interactions between human activities and the Earth's hydrosphere (e.g., septic systems, desalinization, point non-point source pollution).</p> <p>6.2.2. Measure pH, dissolved oxygen (DO), biological oxygen demand (BOD), and temperature and macro invertebrate populations to determine water quality</p> <p>6.2.3. Measure hardness, nitrogen, phosphorus, vegetation, and physical characteristics of lentic and lotic waters to determine water quality</p>

		<p>6.2.4. Explain the hydrological cycle (e.g., condensation, evaporation, transpiration) and how human and animal activity impacts the cycle.</p> <p>6.2.5. Explain the biotic and abiotic factors affecting water quality.</p> <p>6.2.6. Monitor and analyze water quality and quantity.</p> <p>6.2.7. Implement practices that maintain or improve water quality.</p> <p>Outcome 8.3 Pest Management</p> <p>8.3.1. Identify and classify insect, weed, disease and animal pests.</p> <p>8.3.2. Examine the interrelationships among plants, pests, humans and the environment.</p> <p>Outcome 8.4 Growth and Management</p> <p>8.4.9. Manipulate natural and artificial factors to influence plant</p>
	<p>6. Students will understand the fundamentals of plant genetics, diversity, and gene pool.*</p>	<p>Outcome 8.2 Plant Reproduction</p> <p>8.2.3. Compare and contrast variations of plant reproductive systems among plant species.</p> <p>8.2.4. Select seeds and seed stock for desired traits.</p> <p>8.2.5. Select and apply methods that create desired traits in seeds.</p> <p>8.2.6. Select and apply methods of asexual plant propagation for desired traits including grafting, layering, cutting, and cloning).</p>
<p>5. Turf-grass Management: CTAN alignment with the Horticulture Pathway in the Agriculture and Environmental Systems Career Field Technical Content Standards of the Ohio Department of Education</p> <p>General Course Description: Principles of science and engineering will be delivered through the establishment, culture and maintenance of lawns, athletic and recreational turf. Experience is gained in propagation, care, and production of turf-grass. Students will learn to practice safe operation and maintenance of specialized equipment. Environmental awareness and conservation practices will be exercised.</p> <p>Advising Notes: Student must access credit within 3 years of program completion.</p> <p>Semester Credit Hours: 3.0</p>		

Alignment:	<p><i>Asterisked Learning Outcomes are considered essential in the postsecondary curriculum.</i></p>		
	<p>Learning Outcomes The student will be able to:</p>	<p>Outcomes and Competencies from the Horticulture Pathway of the Agriculture and Environmental Systems Career Field Technical Content Standards</p>	
	<p>1. Analyze the structure of the turf-grass plant as it relates to growth, recommended uses and maintenance requirements.*</p>	<p>Outcome 8.4 Growth and Management 8.4.1 Identify and classify plants using taxonomy. 8.4.2. Identify plant anatomical structures and tissues. 8.4.3. Identify and classify seeds and plants at all stages of growth. 8.4.4. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis. 8.4.5. Understand aerobic respiration and its relationship to plant growth and management. 8.4.6. Identify the principles of primary and secondary plant growth.</p>	
	<p>2. Compare and contrast methods of establishing turf- grass for lawns, athletic, and recreational uses.*</p>	<p>Outcome 6.1 Soils 6.1.2. Describe the relationship among physical properties of soils. 6.1.3. Collect, test, and analyze soil samples for physical and chemical properties. 6.1.4. Identify factors (e.g., climate, vegetation, soil texture, drainage, management practices, landscape) affecting organic matter and its function in soil quality 6.1.5. Determine land use and identify land capabilities classes. 6.1.6. Apply soil conservation practices to reduce soil erosion and compaction. 6.1.8. Describe soil limitations in agronomic, urban and natural resource practices. 6.1.9. Evaluate soil survey data and implement management decisions. Outcome 8.2 Plant Propagation 8.2.4. Select seeds and seed stock for desired traits. Outcome 8.4 Growth and Management 8.4.3. Identify and classify seeds and plants at all stages of growth. 8.4.9. Manipulate natural and artificial factors to influence plant germination, growth, and development. 8.4.10. Select, evaluate, and prepare soil or media for planting.</p>	

		<p>8.4.11. Understand and evaluate the process by which plants are selected.</p> <p>8.4.12. Evaluate and implement planting practices (e.g., population rate, germination, seed vigor, inoculation, seed and plant treatments, type of planter, cuttings, pot in pot).</p> <p>8.4.13. Evaluate and implement transplanting practices.</p> <p>8.4.14. Control plant growth through mechanical and chemical means.</p> <p>8.4.15. Analyze plant water requirements and provide water through artificial or natural means.</p>
	<p>3. Calculate the water requirements of turf-grass for lawns, athletic and recreational uses. Compare and contrast methods to provide these requirements.*</p>	<p>Outcome 5.8 Water Distribution Systems</p> <p>5.8.1. Calculate water demand for specific applications.</p> <p>5.8.2. Compare the types, applications and operating principles of and controls.</p> <p>5.8.4. Identify components of supply and drainage systems and describe their functions.</p> <p>5.8.6. Describe factors that are considered when planning and installing a supply and drainage system</p> <p>5.8.9. Select supply and drainage components based on their application for a given purpose.</p> <p>5.8.14. Prevent freezing and mechanical damage to pipes.</p> <p>5.8.15. Describe how water moves from the source through the water distribution system to the fixture.</p> <p>5.8.16. Test a water supply and drainage system for leaks and pressure using soap, inert gas, electronic sensors and fluorescent .</p> <p>Outcome 6.2 Water</p> <p>6.2.1 Assess and explain the interactions between human activities and the Earth's hydrosphere (e.g., septic systems, desalinization, and non-point source pollution).</p> <p>6.2.2. Measure pH, dissolved oxygen (DO), biological oxygen demand (BOD), temperature and macro invertebrate populations to determine water quality.</p> <p>6.2.3. Measure hardness, nitrogen, phosphorus, vegetation and physical characteristics of lentic and lotic waters to determine water</p> <p>6.2.6. Monitor and analyze water quality and quantity.</p> <p>6.2.7. Implement practices that maintain or improve water quality.</p>

		<p>Outcome 8.4 Growth and Management</p> <p>8.4.15. Analyze plant water requirements and provide water through artificial or natural means.</p>	
	<p>4. Develop a fertility program specific to the turf use and site.*</p>	<p>Outcome 8.1 Plant Nutrition</p> <p>8.1.1. Compare and contrast organic and inorganic sources of macronutrients and micronutrients.</p> <p>8.1.2. Describe the functions of macronutrients and micronutrients in plants and the role that microorganisms play in plant nutrition.</p> <p>8.1.3. Determine nutrient requirements of plants.</p> <p>8.1.4. Identify symptoms and causes of plant nutrient deficiencies and toxicities.</p> <p>8.1.5. Collect soil and plant tissue for testing and analysis.</p> <p>8.1.6. Analyze and draw conclusions from soil and plant tissue test data.</p> <p>8.1.7. Distinguish between biotic and abiotic factors (e.g. minerals, pH, microorganisms) that influence and optimize the availability of nutrients for plants.</p> <p>8.1.8. Calculate nutrient requirements and select nutrient sources and additives for optimum economic return.</p> <p>8.1.9. Determine the nutrient content of organic and inorganic fertilizers.</p> <p>8.1.10. Select the methods and time of nutrient application and apply nutrients</p>	
	<p>5. Identify pests and diseases, analyze control methods, and implement controls.*</p>	<p>Outcome 8.3 Pest Management</p> <p>8.3.1. Identify and classify insect, weed, disease and animal pests.</p> <p>8.3.2. Examine the interrelationships among plants, pests, humans and the environment.</p> <p>8.3.3. Analyze and calculate the economic threshold of pest damage.</p> <p>8.3.4. Determine and implement pest management safety practices (e.g., safety data sheets [SDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA], personal protective equipment [PPE], worker protection standards [WPS], refuge management strategy).</p> <p>8.3.9. Develop an IPM plan, based on pest life cycles, available treatments, application methods and the impact on the environment.</p>	

<p>6. Analyze and develop proper turf-grass management practices*</p>	<p>Outcome 8.4 Growth and Management</p> <p>8.4.1. Identify and classify plants using taxonomy.</p> <p>8.4.2. Identify plant anatomical structures and tissues.</p> <p>8.4.4. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.</p> <p>8.4.5. Understand aerobic respiration and its relationship to plant growth and management.</p> <p>8.4.8. Understand the influence of environmental factors on plant growth, development, and maintenance.</p> <p>8.4.9. Manipulate natural and artificial factors to influence plant germination, growth, and development.</p> <p>8.4.14. Control plant growth through mechanical and chemical</p> <p>8.4.15. Analyze plant water requirements and provide water through artificial or natural means.</p> <p>8.4.16 Explain the process and importance of transpiration in plant growth and development</p>
<p>7. Demonstrate accepted maintenance techniques and safe operation of turf-grass equipment.*</p>	<p>Outcome 1.12 Site and Personal Safety Procedures</p> <p>1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.</p> <p>1.12.2. Interpret safety signs and symbols</p> <p>1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.</p> <p>1.12.8. Identify safety hazards and take corrective measures.</p> <p>1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.</p> <p>Outcome 4.1 Tool, Stationary, and Mobil Equipment Maintenance</p> <p>4.1.1. Identify the types of hand tools, power tools and stationary equipment and describe their function.</p> <p>4.1.2. Ensure the presence and functionality of safety systems and hardware.</p> <p>4.1.4. Maintain machinery, equipment, instrument and facility cleanliness, appearance and safety.</p>

	<p>4.1.5. Inspect and service the electrical connections and lamps.</p> <p>4.1.6. Inspect for fluid leakage, fluid levels and the condition of fluids.</p> <p>4.1.7. Clean, lubricate and adjust machinery and equipment.</p> <p>4.1.8. Select fluids, maintain fluid levels and replace system</p> <p>Outcome 4.2 Equipment Operation</p> <p>4.2.1. Follow manufacturer's recommended operating procedures and adjustment specifications.</p> <p>4.2.2. Differentiate among the functions, limitations and proper use of equipment, equipment controls and</p> <p>4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.</p> <p>4.2.4. Perform appropriate start-up, operating and shut-down procedures.</p> <p>4.2.5. Select and operate the equipment and attachments needed to complete the task including levers, pedals or valves.</p>	
<p>8. Identify component costs of turf- grass management</p>	<p>Outcome 1.10 Sales and Marketing</p> <p>1.10.8. Use promotional techniques to maximize sales revenues (e.g., advertising, sales promotions, publicity, public relations).</p> <p>Outcome 5.3 Design and Estimate</p> <p>5.3.4. Develop a program list, including intended use, budget, economics, customer wants and needs and</p> <p>5.3.12. Estimate material, construction and equipment needs, and costs.</p>	