Tennessee Specific Industry Certification for Horticulture Science

Content Areas and Learning Outcomes

**Content Areas**

1. Business Principles
2. Growing Structures and Environmental Controls
3. Plant Genetics and Reproduction
4. Growing Media
5. Landscape Design
6. Plant Anatomy and Physiology
7. Plant Disorders, Diseases, and Pest Management
8. Plant Nutrition
9. Plant Selection and Maintenance
10. Safety
11. Plant & Soil Science
12. Water Management

Content Area: **Business Principles (6%)**

**Learning Outcomes**

1. Define financial terms needed to communicate with financial professionals and to make informed business decisions.
2. Compare and contrast different business models illustrating the advantages and disadvantages of each.
3. Evaluate income statements and balance sheets to recommend strategic profitability models.
4. Describe general business and recordkeeping skills necessary to manage a horticultural business, including scheduling, inventory control, merchandise handling and profit and loss statements.
5. Identify the purpose and parts of a strategic business plan.
6. Summarize the basic management operations of a horticulture nursery.
7. Identify effective marketing strategies for a horticulture business.
8. Develop and evaluate greenhouse production schedules for a representative sampling of greenhouse crops that at a minimum must include: plant selection, plant material cost (seed, plug, and cuttings), growth media, fertilizers, water, testing kits, pricing guides, profit margin, labor, and other expenses.
9. Using industry-specific terminology explain the process for preparing a price estimate for a landscape design project.
10. Understand laws and regulations affecting horticulture businesses.
11. Describe the economic importance of plants in managed ecosystems and the impact of horticultural crops in food systems.
12. Identify and modify the parts of a school-to-career plan in the horticulture industry.
13. Identify professionalism standards for employees in the horticulture industry.
14. Identify how one must prepare for and participate in a job interview in the horticulture industry.
15. Identify careers related to the operation of a horticultural or landscape business.

Content Area: **Growing Structures and Environmental Controls (8%)**

**Learning Outcomes**

1. Evaluate the factors that influence site selection of a production structure and retail greenhouse.
2. Compare the strengths and weaknesses of various growing structures.
3. Compare the strengths and weaknesses of various environmental control systems used in growing structures.
4. Formulate a list of materials needed to construct an aquaponics and/or a hydroponic growing system.
5. Critique a design of a commercial layout for a greenhouse system.
6. Critique a design of a retail garden center layout with parking, greenhouses, office space, etc.
7. Identify both employee and customer safety hazards in a retail garden center layout design.
8. Explain what type of greenhouse is best suited for an operation, ex: propagation, finished plants grower, annual grower, etc.
9. Compare the different methods of heating a greenhouse space for production and retail, considering cost and availability and suitability.
10. Determine the best type of irrigation system for a retail greenhouse vs a production greenhouse.
11. Compare general maintenance and upkeep requirements for a variety of greenhouses in relation to the type of structure and associated systems.
12. Develop a checklist of prescribed maintenance, preventative maintenance, monitoring, and troubleshooting schedules for greenhouse facilities and equipment.
13. Determine the mechanical skills needed for the general maintenance and repair of greenhouses and associated systems such as basic wiring, plumbing, and general construction.
14. Assess the requirements for producing multiple commercial plant species in a controlled environment.
15. Evaluate the greenhouse climate and make recommendations for the proper climate control equipment needed to maintain an optimum growing climate, including but not limited to ventilation, humidifiers, heating, cooling, and shading.
16. Compare and contrast the advantage of automated environmental controls in a greenhouse.

Content Area: **Plant Genetics and Reproduction (10%)**

**Learning Outcomes**

1. Develop and utilize a vocabulary of appropriate terminology to effectively communicate information related to plant genetics and reproduction.
2. Distinguish between simple and complex patterns of inheritance.
3. Recognize the differences in DNA structures and their unique characteristics.
4. Outline the processes of DNA replication and gene expression.
5. Compare and contrast DNA and RNA molecules and their functions.
6. Describe the primary differences between a monocotyledon and dicotyledon plant and flower including their purpose in plant reproduction.
7. Explain the complete life cycle from seed to plant to senescence for the different plant types.
8. Calculate the odds of an organism receiving a specific trait through the use of a Punnett Square.
9. Explain the difference between genotypes and phenotypes.
10. Summarize the relationship between genetics and the distribution of phenotypes to offspring.
11. Summarize the impact of Gregor Mendel’s work on genetics.
12. Explain the importance of genetic engineering.
13. Compare and contrast the positive and negatives of the development and use of GMO’s.
14. Identify appropriate propagation methods for plants grown in a commercial greenhouse and nursery operations.
15. Compare and contrast the following types of plant propagation: cutting, budding, layering, sowing, germination rate calculation, and seed viability.
16. Analyze the reproductive structures in plants and describe functions in both sexual and asexual plant reproduction.
17. Identify the structure and function of different seed components and summarize their roles in plant reproduction and propagation.
18. Explain the detailed process of the top five most commonly used asexual propagation methods.

Content Area: **Growing Media (6%)**

**Learning Outcomes**

1. Compare the difference between using a soilless and a soil-based production operation.
2. Explain appropriate fertilizer selection and application methods for growing media.
3. Identify the main nutrient components needed by plants and different methods of release in growing media.
4. Explain how the pH of a soil/media impacts nutrient availability.
5. Describe four basic types of growing media used in commercial production of edible and ornamental plants.
6. Explain the main functions of growing media.
7. Compare and contrast the differences in organic vs inorganic growing media.
8. Describe the composition, life cycle, and uses of various composts in growing media.
9. Explain the correlation of air space and water holding capacity in growing media along with their function.
10. Evaluate a soil sample to determine soil texture from fine to coarse.
11. Evaluate a soil profile to determine the basic characteristics of each soil type.
12. Recommend specific plant types that will thrive in each type of soil.
13. Describe and identify the different ingredients that may be used in a potting media, and what roles each ingredient may play.
14. Interpret a soil analysis report for different growing media.

Content Area: **Landscape Design (6%)**

**Learning Outcomes**

1. Justify the importance of conducting an initial site analysis for a client.
2. Evaluate a site analysis checklist to assess a proposed landscape site.
3. Explain what drafting tools and design equipment are necessary to create a basic landscape design.
4. Identify landscape design principles and evaluate the components of a comprehensive landscape design plan.
5. Develop comprehensive landscape plans using prospective residential and commercial plots and develop a landscape bid package and presentation for each plan.
6. Identify appropriate methods of on-site water capturing through the use of water gardening in specific scenarios.
7. Review skills required for careers related to landscape design.
8. Describe the basic principles of the use of plant materials in a landscape design.
9. Differentiate between public and private service areas in a landscape design and illustrate these areas in a drawing.
10. Discuss the difference between the terms "softscape" and "hardscape", listing several examples and illustrate these in a drawing.
11. Discuss the principle of "the right plant for the right place" with regards to plant selection, including the use of varieties, cultivars, growing requirements, function and aesthetics.
12. Create a base map and assessment of an area for a landscape design.
13. Define xeriscaping and explain how it can be used in a landscape design.

Content Area: **Plant Anatomy and Physiology (11%)**

**Learning Outcomes**

1. Explain the role cell structure plays in plant development.
2. Evaluate plant interactions with an abiotic or biotic environment.
3. Compare the various stages of sexual plant reproduction.
4. Explain the differences between a monocot and dicot plant with regards to embryo development, flower parts, leaf venation, vascular bundles, and secondary growth.
5. Draw a leaf cross section, labeling the major cell types and describing their functions.
6. Draw and label the parts of a perfect flower containing both non-reproductive and reproductive structures.
7. Describe and illustrate the external parts of a leaf, various leaf types and leaf arrangements.
8. Define and describe the function of outer bark, inner bark, cambium, sapwood and heartwood and their physical relationship in a woody plant.
9. Describe and explain the function of the parts of trees and shrubs.

Content Area: **Plant Disorders, Diseases, and Pest Management (13%)**

**Learning Outcomes**

1. Explain the known historical effects of pesticide on the environment and human health.
2. Evaluate the significance of and define Integrated Pest Management (IPM).
3. Identify common weeds, insects, mites, and plant diseases of commercially grown plants.
4. Review and assess a pest control management schedule for a major crop.
5. Describe plant diseases and vectors and their means of dispersal.
6. Explain the difference between ‘symptoms’ and ‘signs’ of plant diseases and give examples from biotic and abiotic causes.
7. Identify common lawn weeds and indicate which are annuals or perennials, season of germination, and means of reproduction.

Content Area: **Plant Nutrition (10%)**

**Learning Outcomes**

1. Identify the essential nutrients needed for plant growth including major and minor nutrients.
2. Explain how nutrients become available for plants.
3. Interpret a fertilization formulation and identify different methods of fertilizer application.
4. Identify common signs of nutrient deficiencies in plants.
5. Describe the role of soil pH on nutrient availability and overall plant health.
6. Evaluate a basic soil analysis to determine the chemical element and nutritional levels available in soils essential for plant growth.
7. Analyze the nutrient requirements of plants and assess the importance of essential plant nutrients to plant growth and development.
8. Illustrate the process of photosynthesis.
9. Compare and contrast water soluble, granular, and organic fertilizers.
10. Synthesize information on a fertilizer label and be able to estimate usage.
11. Summarize the requirements for nutrients and pH for turf grasses.
12. Analyze the fertilizer needs, if any, of established trees and shrubs.

Content Area: **Plant Selection and Maintenance (13%)**

**Learning Outcomes**

1. Identify and recommend common vegetable, fruit, forage, field, and landscape (ornamental and turf) crops.
2. Recommend growing schedules for commonly used vegetable, fruit, forage, field, landscape, and turf crops.
3. Develop a basic lawn, shrub and tree maintenance program including weed control, mowing, pruning, fertilizing, and pest management.
4. Recommend appropriate, effective and integrated approaches to produce and maintain high-quality food and ornamental crops.
5. Differentiate function, form, and growth requirements for common perennials, annuals, and biennials.
6. Assess methods for general care and maintenance of ground covers, vines, and plants including planting, pruning, mulching, and fertilizing techniques.
7. Recommend and justify specific vines and groundcovers to solve special landscaping issues.
8. Identify and distinguish between common tree and shrub species used for landscaping and describe research based practices in harvesting, transportation, transplanting and care.
9. Justify by drawing on research and technical data, the importance of the site evaluation, preparation, and consideration of hardiness zones in the selection of trees and shrubs.
10. Classify ornamentals, shrubs, and trees by their growth habit.
11. Identify and classify basic ornamental flowers and plants used for the commercial interior plant scape, and summarize their installation techniques, and maintenance requirements.
12. Demonstrate the ability to construct an interior display using a variety of plant materials, including but not limited to foliage, flowering plants, (both cut and potted), live, and permanent/silk plants.
13. Identify and compare/contrast the functions and components of turf grass species to determine appropriate recommendations.
14. Describe establishment and maintenance methods of turf grasses, including soil preparation, installation, watering/fertilizer application, and nutrient/pH calculations and adjustments.
15. Evaluate and compare the different management requirements of residential, commercial, and sports turf.
16. Identify management practices and associated equipment requirements for mowing, irrigation, and weed, disease, and fungus control for common turf grass species.
17. Understand the importance of binomial nomenclature and its use.
18. Explain the anatomical and physiological differences between plant species.
19. Understand light requirements for specific horticultural crops as it relates to plant selection and maintenance.
20. Differentiate growth requirements for common perennials, annuals, and biennials as it relates to plant selection and maintenance.

Content Area: **Safety (5%)**

**Learning Outcomes**

1. Articulate processes that must be taken to keep employees safe in a horticulture business.
2. Explain the importance of keeping records as it relates to safety.
3. Describe the current top five citations from OSHA each year and explain how a citation could have been prevented.
4. Identify components of the Food Safety Modernization Act (FSMA) including potential FSMA violations in a familiar horticulture enterprise.
5. List potentially hazardous materials utilized in various horticulture enterprises.
6. Demonstrate the proper procedures to take when encountering hazardous materials.
7. Discuss the requirements of the Agricultural Worker Protection Standard.
8. Interpret a pesticide product label correctly.
9. Discuss pesticide safety and the use of Personal Protective Clothing (PPC) and Personal Protective Equipment (PPE) when mixing and spraying pesticides.
10. Identify four ways that pesticides can enter the body and list common signs and symptoms of pesticide poisoning.
11. Describe the safety rules to observe when transporting pesticides in a car or truck and the safety rules to follow when storing pesticides.
12. List the three “Cs” of pesticide spill management and explain the actions to take under each category.
13. Explain where to find directions on safe disposal of leftover pesticides and what to do with leftover pesticides.

Content Area: **Plant and Soil Science (6%)**

**Learning Outcomes**

1. Explain how soil fertility is determined and how plant nutrient deficiencies are identified.
2. Describe potential ways to improve soil fertility.
3. Determine soil health based on descriptions provided in scenarios.
4. Apply diagnostic skills for addressing soil constraints, irrigation, nutrients, and stress issues.
5. Identify and describe the characteristics of the major soil types.
6. Explain the process of capillary action in soil.
7. Draw a soil profile and describe in detail the significance of each layer.
8. Describe in detail what is meant by soil judging, what aspects are determined through soil judging and methods used to measure these aspects.
9. Create a remediation plan for a plot of land that has been depleted.
10. Describe the correlation of the Munsell color chart as it relates to its organic and mineral content of soil.

Content Area: **Water Management (6%)**

**Learning Outcomes**

1. Apply maintenance strategies to maintain a healthy water garden or pond, addressing at minimum the following considerations: pH, nitrate, dissolved oxygen, algae, pollutants, filter requirements, and fish feed schedules.
2. Compare and contrast different irrigation systems and summarize their advantages and disadvantages.
3. Identify irrigation tools and system components and their function and/or application.
4. Calculate the water supply flow rate, head pressure requirements, and pipe and pump size considerations for a water garden, pool, pond or irrigation system.
5. Identify the plumbing skills required to install irrigation and water features in a landscape or turf setting.
6. Discuss the design requirements for an irrigation system for a residential landscape and develop a bid presentation that identifies the project timeline, required permits, and costs of installation and selected materials.
7. Distinguish between runoff and erosion.
8. Explain the importance of a riparian zone and its significance to the environment.
9. Discuss the correct procedure for collecting water samples from different surface water sources, such as pond, river, etc., and city water sources.
10. Evaluate pH of water samples with a pH meter or litmus paper, compare how pH changes with introduction of a base or acid and describe the difference.
11. Explain how water samples for salt and nutrient content are taken and analyzed.
12. Justify the most effective type of irrigation system for specific crops on sites based on available water resources.
13. Diagram an irrigation system using appropriate sized pump, pipe, and delivery system to fit the needs of a simulated horticultural crop.
14. Demonstrate an understanding of the key components of a water management system.
15. List the key factors that indicate water quality and ways to manipulate each factor.
16. Explain the impact of different types of pumps, flow rates of pipe sizes ½” to 10” in gallons per minute, friction loss, and the correlation between pressure and volume when calculating GPM.
17. Given specific parameters, calculate the flow and pressure requirements of a landscape irrigation system.
18. Describe basic management operations of a hydroponic system.