

# Horticulture Systems Standards and Skills

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## Health & Safety Standards

### Standard 1: Safety and Health in a Horticulture Environment

Students will apply essential health and safety practices for managing and maintaining equipment and tools required for various roles in the horticulture industry, including proper use of personal protective equipment (PPE), adherence to safety protocols, safe handling of hazardous materials, and preparedness for emergency situations, in accordance with industry standards.

* Aligned Industry Recognized Credentials: OSHA10 – General Industry

#### Skills:

1. Identify, describe, and demonstrate the effective use of Safety Data Sheets (SDS) to meet documentation requirements.
2. Locate emergency equipment, e.g., first aid kit, fire extinguisher, and review the emergency action and response plan, including labels and signage following OSHA’s Hazard Communication Standard (HAZCOM).
3. Demonstrate an understanding of ANSI Z133 standards as they pertain to equipment safety, hazard recognition, and emergency response procedures within the horticulture trade.
4. Understand and apply fire safety protocols, including the identification of fire hazards, appropriate evacuation procedures, and the correct use of fire extinguishers.
5. Identify and compile contact information for relevant health and safety agencies and resources to incorporate into the emergency response plan.
6. Demonstrate safe dress and appropriate use of PPE, including gloves, protective clothing, proper footwear, knee pads, earplugs, eye protection, helmets, and dust masks or respirators when required.
7. Demonstrate safe body mechanics, including proper lifting techniques and ergonomics to prevent injury.
8. Demonstrate safe use, proper inspection, maintenance, and storage of hand and power tools, following manufacturer guidelines.
9. Explain OSHA’s four high hazard areas (falls, electrocutions, struck by, and caught between) that contribute to serious workplace injuries and fatalities.
10. Describe safety practices and procedures to be followed when working with and around electricity, e.g., ground fault circuit interrupter (GFCI) and frayed wiring.
11. Demonstrate the safe handling, application, storage, and disposal of horticultural and hazardous chemicals. e.g., fertilizers, herbicides, pesticides, in compliance with EPA, local, and state environmental safety regulations.
12. Identify and apply safe storage and handling of flammable and combustible materials to reduce fire risks.
13. Apply safety and health precautions when working in adverse weather conditions, identifying potential hazards associated with sun exposure (UV rays), summer heat (heat stroke, heat exhaustion, dehydration), extreme cold (hypothermia, frostbite, dehydration), and storm weather (lightning, high winds, mixed precipitation, freezing surfaces).
14. Identify potential safety and health hazards encountered in outdoor environments by recognizing risks associated with insect-borne diseases, e.g., Lyme disease, Eastern Equine Encephalitis, malaria, hazards from animals, e.g., rabies, biting risks, and adverse reactions from plants, e.g., poisonous plants, irritations, allergies.
15. Demonstrate appropriate workspace cleaning, sanitation, disinfection, and sterilization procedures required in specific occupational areas, e.g., Workplace Housekeeping OSHA Regulations.
16. Identify and describe potential consequences for non-compliance with appropriate health and safety regulations.

## Technical & Integrated Academic Standards

### Standard 2: Role of Horticulture Professionals in Society

Students will analyze the evolution of horticulture professionals in society, focusing on their contributions to environmental sustainability, biodiversity, and the impact of relevant legislation on safety and sustainable practices.

#### Skills:

1. Analyze the evolution of horticulture as a profession, understanding key milestones and technological advancements that have shaped the field.
2. Identify and analyze the diverse roles in horticulture, e.g., landscape architects, floral designers, greenhouse managers, urban planners, and evaluate their specific contributions to community development and food security.
3. Evaluate the impact of horticulture professionals on environmental sustainability and biodiversity by analyzing informed practices that respond to challenges such as climate change, Integrated Pest Management, and efficient resource use.
4. Examine the impact of the Massachusetts Pesticide Control Act, the Massachusetts Wetlands Protection Act, and EPA guidelines on safety standards, environmental protection, and sustainable practices within the horticulture profession.

### Standard 3: Introductory Botany

Students will apply plant classification principles to identify and categorize a diverse range of plant species, utilizing hierarchical systems and nomenclature standards while analyzing the significance of plant structures and life cycles in their ecological roles.

#### Skills:

1. Utilize plant classification principles to systematically identify a diverse range of plant species.
2. Categorize and classify plants using hierarchical systems to illustrate the relationships between different plant groups.
3. Employ a dichotomous key to accurately identify plant species based on observable characteristics.
4. Apply correct nomenclature to classify plants, ensuring adherence to established naming conventions in botany.
5. Analyze the roles of common plant parts in the classification process to understand their significance in identifying plant species.
6. Compare and contrast the characteristics of angiosperms, gymnosperms, and ferns to evaluate their distinct features and reproductive strategies.
7. Classify plants according to their lifecycle categories, e.g., annual, perennial, and biennial, to understand their growth patterns and ecological roles.

### Standard 4: Plant Biology and Anatomy

Students will be able to apply their understanding of plant biology and anatomy to describe cellular structures and functions, differentiate between reproductive strategies, and use this knowledge to analyze and propagate various plant species.

#### Skills:

1. Demonstrate an understanding of plant cell biology by describing the structure and function of plant cells.
2. Identify the differences between prokaryotic cells and eukaryotic cells.
3. Distinguish the roles of organelles in plant cells and their contributions to cellular processes.
4. Explain the principles of plant genetics, including the roles of DNA, alleles, and gene expression in trait inheritance.
5. Compare and contrast mitosis and meiosis, explaining where both processes occur in the plant lifecycle and their significance in growth and reproduction.
6. Demonstrate an understanding of plant anatomy by outlining the major structures and functions of plant organs.
7. Explain the major structural differences between monocots and dicots, relating these differences to their growth patterns and ecological roles.
8. Identify the forms, functions, and tissues associated with root systems, understanding their importance for water and nutrient uptake.
9. Outline and describe the pathways water and nutrients take into the plant, including processes such as osmosis and active transport.
10. Describe the functions of plant stems, including support, transport, and storage.
11. Compare the composition and characteristics of herbaceous and woody stems and their structural adaptations.
12. Identify internal and external leaf components and their functions, such as light absorption and transpiration, to understand photosynthesis.
13. Compare and contrast leaf arrangements and types, evaluating how these variations influence plant efficiency and adaptation.
14. Identify the components and functions of a flower and its role in plant reproduction.
15. Examine different forms of flowers and their effects on reproductive strategies and adaptations for pollination.
16. Explain the major types, functions, and dispersal methods of fruits and their role in seed propagation.
17. Classify the major categories and parts of seeds, their structure, and significance for plant development.
18. Distinguish between sexual and asexual reproduction in plants.
19. Identify various forms of sexual and asexual reproduction and evaluate their advantages and disadvantages in terms of genetic diversity and adaptability.
20. Explain the processes of fertilization and pollination and the anatomical structures involved in each process.
21. Demonstrate the propagation of plants both sexually and asexually using techniques such as seeds, cuttings, budding, and grafting, and recognize modern propagation innovations such as tissue culture and micropropagation.

### Standard 5: Plant Physiology and Growth

Students will apply principles of plant physiology and metabolism to analyze and enhance plant growth in various environments, utilizing technology and ethical considerations in plant management.

#### Skills:

1. Explain the importance of plant physiology in agriculture and environmental science, including how plant processes can lead to improved cultivation practices and sustainable agriculture.
2. Identify factors that impact plant growth, including water, nutrients, light, air, and temperature, and assess their effects on overall plant health.
3. Describe the process of transpiration and evaluate how environmental factors influence its rate and significance in plant hydration.
4. Explain the processes of photosynthesis, including light-dependent and light-independent reactions, and assess their roles in energy production for plants.
5. Analyze how the availability of water, carbon dioxide, and light affects the rate of photosynthesis, and contributes to overall plant development.
6. Explain the process of cellular respiration and identify factors that affect its rate and discuss its importance in energy metabolism for plants.
7. Evaluate the macro and micronutrients necessary for healthy plant growth, their roles in plant development, and physiological functions.
8. Identify and explain plant tropisms, including phototropism and gravitropism, and analyze the environmental factors that influence these responses.
9. Utilize plant hormones such as auxin, cytokinin, gibberellins, and abscisic acid to manipulate and optimize plant growth and development.
10. Describe how water and nutrients move through a plant using models such as the cohesion-tension theory (xylem transport) and the pressure-flow hypothesis (phloem transport).
11. Examine how plant growth regulators (PGRs) are used in commercial horticulture to manage growth, flowering, and rooting.
12. Analyze how plants respond to abiotic stresses, such as drought, salinity, and extreme temperatures, and the physiological adaptations they employ.
13. Investigate strategies to enhance photosynthetic efficiency in different plant species through environmental modifications.
14. Investigate the role of biotechnology in enhancing plant traits, such as disease resistance and drought tolerance.
15. Discuss ethical considerations and real-world implications of using genetically modified organisms (GMOs) in horticulture, including effects on biodiversity, food systems, and global agriculture.

### Standard 6: Plant Health Care and Integrated Pest Management (IPM)

Students will be able to apply their understanding of entomology, plant pathology, and plant physiology to assess and manage plant health, using sustainable strategies to enhance ecosystems and improve agricultural productivity.

#### Skills:

1. Analyze the characteristics and life cycles of insects, identifying key stages and behaviors that affect plant health.
2. Evaluate insect damage types, e.g., piercing-sucking, chewing, skeletonizing, and disease transmission, and their impact on plant vitality.
3. Apply appropriate integrated strategies for insect control, combining biological, cultural, and chemical methods.
4. Apply monitoring techniques to assess pest populations and environmental conditions, utilizing tools such as sticky traps, pheromone traps, and visual inspections to track insect activity and determine threshold levels for informed pest management decisions.
5. Describe the characteristics and ecological effects of invasive insects, emphasizing their role in altering native ecosystems.
6. Evaluate the ecological risks of invasive insect species and explore how promoting native or beneficial insects can support natural pest control.
7. Explain the principles of insect population dynamics, particularly the concept of economic thresholds for pest management.
8. Identify and categorize the characteristics and life cycles of pathogens, including bacteria, viruses, and fungi, relating them to plant health.
9. Assess pathogen damage types, e.g., blight, necrosis, blotches, scorch, and their implications for plant survival and productivity.
10. Develop and recommend strategies for pathogen control, including preventative, systemic, and contact methods, within an IPM framework.
11. Implement monitoring practices for assessing both nutrient status and pathogen presence in plants, using techniques like soil testing and visual inspections.
12. Demonstrate the use of digital tools, such as sensors, drones, and imaging software, to monitor plant health, growth rates, and environmental conditions.
13. Analyze data collected to make informed decisions about plant care and management.
14. Examine the impact of invasive pathogens on ecosystems, focusing on their role in biodiversity loss and plant health deterioration.
15. Identify common nutrient disorders (NPK, Fe, Mg, pH imbalance) and explain their effects on plant physiology and growth.
16. Assess signs of water stress in plants and recommend appropriate interventions to restore health.
17. Analyze the impact of nutrient-deficient soil on plant growth, proposing solutions for improvement.
18. Compare and contrast nutrient deficiency and phytotoxicity, including symptoms and management strategies.
19. Determine whether lacking nutrients are mobile or immobile within the plant system and explain their implications for treatment.
20. Identify and apply cultural practices that enhance plant health, such as crop rotation, proper irrigation, and mulching, to prevent diseases and nutrient deficiencies.
21. Describe the components and benefits of a comprehensive plant health care plan, highlighting its role in sustainable management.
22. Explain the use of cultural, biological, and chemical strategies in an Integrated Pest Management (IPM) and Plant Health Care Plan, providing justifications for each method.
23. Evaluate current pest and disease threats and design an Integrated Pest Management plan that utilizes sustainable practices and minimizes chemical reliance.
24. Apply ecological design principles by evaluating the benefits of native and well-adapted introduced plants in landscape design, while identifying the ecological risks of invasive species and recommending sustainable alternatives.
25. Describe optimal soil conditions to support beneficial soil organisms, ensuring plant health and resilience.
26. Distinguish between organic and inorganic fertilizers, explaining their roles and impacts on plant health and the environment.

### Standard 7: Pesticide Management

Students will be able to demonstrate the knowledge and skills required to pass the Massachusetts Pesticide Applicator CORE License exam, including safe pesticide handling, understanding of labeling and regulations, and responsible application practices.

* Aligned Industry Recognized Credentials: MA Pesticide Applicator (core) License

#### Skills:

1. Identify and understand state and federal regulations related to pesticide application, including the Massachusetts Pesticide Control Act.
2. Demonstrate safe handling, storage, required PPE, and disposal of pesticides; understand Safety Data Sheets (SDS); and maintain record-keeping practices to ensure compliance with regulations and industry standards.
3. Explain pesticide labels, determining contents such as active ingredients, application rates, and safety precautions.
4. Identify and explain the signal words on labels, e.g., Caution, Warning, and Danger, and their implications for pesticide safety.
5. Identify chemical points of entry into the body (dermal, oral, and inhalation routes) to understand potential exposure risks.
6. Utilize proper mixing techniques for different pesticide types and formulations.
7. Explain proper methods for applying pesticides, including equipment calibration and application rates.
8. Clean, inspect, and care for pesticide application tools following appropriate industry and manufacturer guidelines.
9. Investigate various pesticides and their potential impacts on non-target organisms, such as beneficial insects, wildlife, and aquatic ecosystems.
10. Define and explain the EPA Worker Protection Standard for agricultural pesticide safety, highlighting its importance in protecting agricultural workers.
11. Analyze the impact of increasing pesticide resistance and emerging pest challenges, and research innovative management strategies including biocontrols, biotechnology, and precision agriculture tools that support sustainable IPM.
12. Demonstrate knowledge of the enforcement mechanisms and penalties associated with pesticide non-compliance to promote adherence to regulations.

### Standard 8: Soil Formation and Physical Properties

Students will be able to explain the processes of soil formation and identify key soil properties by analyzing factors such as parent material, weathering, soil horizons, and texture to support informed land use and horticultural decisions.

#### Skills:

1. Demonstrate an understanding of soil formation, listing factors that contribute to soil development and explaining how parent material influences soil characteristics.
2. Compare and contrast weathering processes, explaining the differences between chemical and physical weathering and their effects on soil formation.
3. Identify and explain soil movement, listing the forces that contribute to soil transport and their impact on soil profiles.
4. Define soil horizons, describing the various layers within a soil profile and their significance in soil health.
5. Classify soil texture by defining the three soil separates and identifying various textural classes, including loam.
6. Perform a soil texture test, determining the soil's texture and conducting a ribbon test to classify it accurately.
7. Define macro and micro pores, explaining their role in how soil compaction affects water movement and root growth.
8. Explain water movement, discussing the relationships among percolation, permeability, and infiltration in an ideal growth medium.
9. Describe how soil structure influences water retention and root development.
10. Explain composting processes, outlining the stages of decomposition that produce humus and its benefits for soil structure.
11. Explain the role of the soil microbiome, including bacteria, fungi, and archaea, and their contributions to nutrient cycling, disease suppression, and plant growth.
12. Evaluate organic matter, comparing its positive and negative aspects on soil health and plant growth.
13. Explain how soil water potential, including matric and gravitational potential, affects water availability and movement, and its importance to plant health.
14. Explain capillary action, capillary rise, and osmosis, explaining their roles in water movement within soil.

### Standard 9: Relationships of Soil Life to Plant Health

Students will be able to evaluate the relationship between soil life and plant health by analyzing nutrient cycling and the roles of soil organisms and apply soil management practices that promote long-term sustainability and productivity.

#### Skills:

1. Explain food chain dynamics, detailing the dependence of food chains on soil and the critical role of decomposers in nutrient cycling.
2. Identify and classify different types of soil organisms and their functions.
3. Explain nutrient cycling processes, including decomposition, immobilization, and mineralization within the nitrogen and carbon cycles.
4. Describe the role of mycorrhizae and their importance in nutrient uptake for plant roots.
5. Evaluate the relationship between root systems and soil health, including how soil composition affects nutrient uptake and plant growth.
6. Demonstrate techniques that encourage beneficial soil organisms while controlling harmful ones.
7. Describe cation exchange capacity, its significance in nutrient availability, and soil fertility.
8. Identify factors affecting nutrient uptake, including inhibitors of nutrient absorption and the influence of soil pH.
9. Explain nutrient uptake mechanisms, describing root interception, mass flow, and diffusion processes.
10. Assess soil pH, identifying factors that contribute to soil pH, and discussing its buffering capacity.
11. Analyze the importance of soil testing, providing reasons for conducting tests and describing methods for soil analysis.
12. Perform basic soil tests that assess soil fertility, including executing tests for pH and N-P-K content.
13. Demonstrate preparing soil samples for laboratory testing, outlining the steps for collecting, packaging, and submitting samples for commercial analysis and interpreting the results.
14. Demonstrate techniques for adjusting soil pH through modification of soil acidity or alkalinity.
15. Identify causes of soil salinity and propose management strategies.
16. Evaluate the impacts of different land use practices on soil health and biodiversity, including urban development and agricultural practices.
17. Analyze fertilizer content to determine the N-P-K ratios in various fertilizers, evaluating their suitability for specific crops and minimizing environmental impacts, such as nutrient runoff.
18. Analyze sustainable soil management practices, including cover cropping and no-till farming, and their benefits for soil health and ecosystem resilience.
19. Explore technological advances in soil analysis and management, such as soil moisture sensors, GIS mapping, variable rate technology (VRT), and data-informed decision platforms.

### Standard 10: Agribusiness Fundamentals in Horticulture

Students will be able to apply business and marketing principles in horticulture by evaluating business models, setting pricing strategies, managing inventory, delivering customer service, and developing marketing plans aligned with market demands to support successful and sustainable enterprises.

#### Skills:

1. Identify and describe different horticultural business models, such as nurseries, garden centers, floral design businesses, greenhouse management, landscaping services, and garden maintenance businesses, and explain their strengths, challenges, and how they meet local market needs.
2. Analyze emerging trends in horticulture, such as urban farming, vertical gardening, and plant-based wellness products, and their influence on market needs and business strategies.
3. Examine sustainable business practices in horticulture, such as eco-friendly products, waste reduction, and resource conservation strategies.
4. Understand the concept of supply and demand in the horticulture market and analyze how seasonal changes, consumer preferences, and regional factors affect the availability and pricing of horticultural products and services.
5. Create a basic pricing strategy for a horticulture business using pricing methods such as cost-plus pricing, and evaluate how different pricing strategies impact profitability, market competitiveness, and consumer demand.
6. Track basic costs of goods sold (COGS) to understand how fluctuating costs, e.g., transportation, labor, raw materials, influence profitability and product/service pricing in horticultural enterprises.
7. Utilize inventory tracking systems, such as spreadsheets or software tools, to maintain an up-to-date inventory of materials, e.g., seeds, soil, tools, and products, e.g., plants, gardening supplies, ensuring accurate stock levels and efficient operations.
8. Implement basic customer service techniques to ensure client satisfaction, addressing common client concerns, providing solutions, and building customer loyalty in horticultural businesses.
9. Explain the 4Ps of marketing (Product, Price, Place, Promotion) to attract, engage, and retain customers.
10. Develop and implement a marketing plan for a landscape project or business, utilize social media platforms and appropriate marketing tools to reach target audiences, increase engagement, and promote services effectively.
11. Examine the role of e-commerce platforms in the horticulture market and how businesses can utilize online sales channels to expand their reach.
12. Examine the logistics of delivering horticultural products, including packaging methods, transportation options, and delivery timelines, to ensure products arrive in good condition and meet customer expectations.

## Arboriculture (Standards 11 – 15)

### Standard 11: Equipment and Tool Use and Maintenance in Arboriculture

Students will be able to safely operate, maintain, and care for essential arboricultural equipment and tools, including chainsaws, chippers, ropes, and lines ensuring compliance with ANSI standards.

#### Skills:

1. Identify and select tools for maintaining arboricultural equipment and apply proper techniques for their effective and safe use.
2. Conduct routine inspections and maintenance of arboriculture equipment and tools following manufacturer’s recommendations to ensure equipment is in safe working condition.
3. Accurately identify the safety features and operational requirements for all equipment used, e.g., chainsaws, chippers.
4. Operate a chainsaw safely and efficiently, wearing appropriate PPE, including chaps, hard hat, eye protection, ear protection, and other suitable attire whenever a chainsaw is in use.
5. Explain the function of chaps and the mechanics of kickback and reactive forces.
6. Label basic parts of a chainsaw and demonstrate leglock and ground start procedures.
7. Execute upward and downward cuts using a chainsaw while adhering to safety protocols.
8. Apply manufacturer specifications to mix fuel and oil for a 2-cycle engine, and demonstrate basic chainsaw maintenance, including cleaning, sharpening, and caring for the bar and chain.
9. Explain the maintenance and operation of battery-powered and hybrid chainsaws, including the proper care of the battery system, charging protocols, and their environmental benefits over gas-powered chainsaws.
10. Apply proper ergonomic techniques when operating a chainsaw to prevent back injuries and enhance overall safety and efficiency.
11. Operate a chipper demonstrating proper feeding techniques and ergonomic positioning, according to manufacturer specifications.
12. Differentiate between disc and drum chippers and identify safety features and danger zones.
13. Demonstrate inspection and scheduled maintenance of a chipper.
14. Demonstrate properly attaching a chipper to a truck and apply road safety precautions.
15. Understand Massachusetts Hoisters License requirements for operating aerial lifts.
16. Compare various types of aerial lifts and describe their attributes.
17. Demonstrate setup and operation procedures for aerial lifts and the use of fall arrest harnesses.
18. Explain hazards associated with shock loading an aerial lift and describe multiple methods for aerial rescue.
19. Conduct pre-travel preparations, ensuring all booms are stowed and locked, if applicable.
20. Understand and practice emergency procedures for dealing with equipment failures or accidents during lifting operations.
21. Differentiate between 3-, 12-, 16-, and 24-strand lines and compare climbing lines of varying lengths and diameters.
22. Inspect and care for ropes, explaining strength loss in knots and splices.
23. Demonstrate the tying, dressing, setting, and appropriate use of essential knots and hitches, such as the Bowline, Figure 8, and Prusik.
24. Compare safe working load and tensile strength, differentiating between weight and force.
25. Utilize digital measuring devices, such as laser distance meters, to accurately measure tree heights, distances, and clearances.
26. Interpret and apply measurements taken with precision tools for planning tree work, including pruning, removals, and planting.
27. Demonstrate proper calibration and maintenance of digital measuring devices to ensure accurate readings.
28. Identify basic components of small engines, differentiating between two- and four-cycle engines, as well as gas and diesel engines.
29. Demonstrate the operation and maintenance of a stump grinder and brush cutter, following manufacturer specifications and industry standards.
30. Use winches following industry-approved techniques and perform inspections for safety and functionality.

### Standard 12: Tree Climbing Safety and Skills

Students will be able to apply tree climbing safety protocols by identifying potential hazards, selecting appropriate gear, and demonstrating safe climbing techniques in a controlled environment.

#### Skills:

1. Perform a pre-climb inspection of the tree and surrounding area to identify potential hazards.
2. Conduct a pre-climb gear inspection on all equipment to ensure safety and functionality.
3. Explain the components of an electrical hazard awareness program to recognize and mitigate risks.
4. Use appropriate verbal call-and-response communication, e.g., “Stand clear,” “All clear,” to enhance team safety.
5. Select and evaluate climbing rope according to ANSI standards, considering tensile strength, safe working load, and environmental factors.
6. Determine tie-in location and acceptable diameters relative to tree species, tree health, and task requirements to ensure secure climbing.
7. Compare different methods of rope installation, considering load distribution, potential hazards, ease of use, and the specific requirements of the climbing task ensuring compliance with manufacturer guidelines and ANSI standards.
8. Describe and demonstrate safe ladder use according to current industry standards covering proper setup, stability checks, maintenance practices, and techniques for safe ascent, descent, and work from a ladder.
9. Explain the purpose and application of a re-direct in climbing to manage rope angles and load distribution.
10. Describe the concept of double crotching to increase safety and efficiency while minimizing the risk of equipment damage and falls.
11. Explain the proper use and safety limitations of mechanical ascenders.
12. Install a climbing line effectively and securely to facilitate safe ascent.
13. Install a false-crotch/cambium saving device properly to protect the tree and equipment.
14. Use a lanyard safely to advance a rope, ensuring safety during transitions.
15. Apply ergonomic techniques in tree climbing to reduce fatigue and enhance efficiency, including proper body positioning, tool usage, and movement strategies to minimize strain during climbs.
16. Evaluate and adapt climbing strategies based on environmental conditions, such as adjusting techniques for varying weather, tree health, and site-specific factors.
17. Demonstrate climbing techniques, including body thrusting, modified footlock, and secured footlock.
18. Describe and demonstrate single line climbing techniques for efficiency and safety.
19. Explore emerging techniques in single line climbing and the use of advanced friction management systems to enhance climbing safety, efficiency, and reduce wear on climbing ropes.
20. Use climbing spurs safely while on belay to maintain stability and ensure safety during tree climbing operations.
21. Examine wearable technology in tree climbing used to monitor climber safety, including fall detection devices, health trackers, or GPS-enabled devices for positioning and safety communication.
22. Demonstrate safe limb walking techniques to navigate the tree effectively.
23. Descend safely using a friction hitch or mechanical descender to ensure controlled descents.
24. Demonstrate proper ground working skills in a tree climbing context, including techniques for securing equipment, managing ropes, and communicating effectively with climbers.

### Standard 13: Tree Identification and Maintenance

Students will analyze tree species, apply scientific principles for transplanting and pruning as defined by ANSI A300 standards, and assess tree support and health according to ISA standards, demonstrating a comprehensive understanding of effective tree maintenance practices.

#### Skills:

1. Explain tree anatomy and its relevance to species identification while utilizing common and scientific nomenclature.
2. Employ a reference guide or identification key to classify various tree species, effectively differentiating between coniferous, deciduous, and deciduous-coniferous trees, in accordance with the Massachusetts FFA Arbor Skills CDE.
3. Describe standard techniques for excavating trees and preparing them for transport.
4. Calculate the appropriate size of a root ball for successful transplanting, following the guideline of 9"-12" of root ball per inch of trunk diameter.
5. Assess various transplanting methods, e.g., balled and burlapped, bare root, containerized, for effectiveness and suitability.
6. Execute burlapping and movement of a root ball in accordance with industry standards.
7. Prepare a planting hole according to industry standards, ensuring proper planting depth and soil quality to facilitate healthy tree establishment and successful transplanting.
8. Demonstrate the proper removal of containers, burlap, wire baskets, and trunk wrap for tree preparation to ensure successful transplanting.
9. Explain the importance of post-transplant care, e.g., watering, mulching, in minimizing transplant shock.
10. Compare and contrast various mulch types, evaluating their benefits and correct application techniques.
11. Conduct a support needs assessment for newly transplanted trees and explain the appropriate staking or guying techniques.
12. Identify causes of construction-related tree damage and propose effective remediation strategies.
13. Execute pruning practices that conform to ANSI A300 standards.
14. Identify, utilize, and maintain common pruning tools safely and effectively.
15. Analyze a tree's physiological response to pruning while applying principles of Compartmentalization of Decay in Trees (CODIT).
16. Explain tree structural dynamics and their implications for effective pruning practices.
17. Locate and explain the functions of the branch bark ridge and branch collar in relation to callus tissue development.
18. Connect the concepts of wound dressing to the process of wound closure in trees.
19. Describe various pruning objectives, including crown cleaning, thinning, raising, reduction, restoration, and utility pruning.
20. Demonstrate the procedure to make precise pruning cuts on limbs of varying sizes.
21. Explain the rationale behind specialty pruning methods, including their purposes, benefits, and appropriate applications in tree care.
22. Explain the reasons to avoid topping trees and describe the long-term consequences of this practice.
23. Utilize digital tools and sensors for real-time tree health monitoring, including soil moisture sensors and tree vitality apps that provide data for informed decision-making in tree care.
24. Explain techniques for bracing, cabling, and guying trees in accordance with ANSI standards.
25. Evaluate and install cabling systems, demonstrating their effectiveness, suitability, and adherence to industry standards.
26. Explain the principles of lightning protection and how they apply to maintaining tree health.
27. Describe and demonstrate various tree fertilization methods to enhance tree health.
28. Implement basic scouting techniques as part of an integrated Plant Health Care (PHC) program, which focuses on monitoring and maintaining tree health through proactive management practices.

### Standard 14: Tree Removal

Students will be able to perform tree removal operations, demonstrating proficiency safely and effectively in developing felling plans and applying appropriate techniques in accordance with ANSI standards.

#### Skills:

1. Demonstrate execution of limbing, felling, and bucking techniques in accordance with current industry standards.
2. Assess tree height using various measurement techniques and justify the chosen method for tree removal.
3. Examine a felling site to identify and assess potential obstacles and hazards.
4. Differentiate between cuts, notches, hinges, and back-cuts, providing rationale for each function.
5. Execute a bore cut for the back-cut using appropriate techniques, reflecting on the implications of technique choice.
6. Develop a felling plan that includes hazard identification, tree lean analysis in two planes, escape route planning, hinge size determination, and back-cut strategy.
7. Interpret the use of felling sights and their impact on felling accuracy.
8. Investigate the phenomenon of barber chairing and its implications for safety during felling operations.
9. Explain the role of force in a felling plan, including the use of felling wedges, levers, ropes, and machinery, and evaluate their effectiveness.
10. Evaluate and measure a tree’s potential for lumber, firewood, or value-added uses, considering opportunities for urban wood reuse and sustainable material recovery.
11. Identify various markets and sustainable strategies for managing green waste, including composting, biochar production, mulch processing, and community-based reuse opportunities.

### Standard 15: Hoisting and Rigging in Arboriculture

Students will assist with hoisting and rigging tasks specific to arboriculture by determining the center of gravity of trees, limbs, and other materials to be moved, selecting appropriate rigging equipment, and effectively communicating with the crane operator. Schools must pursue a variance with the Office of Public Licensure to allow for students to take the Hoisting Licensure exam at 16. Students must pass the test before operating hoisting equipment.

* Aligned Industry Recognized Credentials: MA Hoisting Apprentice License

#### Skills:

1. Identify and describe the working parts of hoisting machinery and rigging equipment used in arboriculture, including tree trucks, ropes, pulleys, and rigging components like slings, to ensure safe operating procedures.
2. Identify and explain the function of modern PPE technologies, including harnesses with built-in shock absorbers and other safety devices used in tree work.
3. Accurately estimate the weight of branches or trees being lifted based on their size and structure to ensure safe handling and compliance with equipment limits.
4. Conduct a site inspection to assess the surrounding environment for potential hazards, such as energized conductors, power lines, unstable terrain, and nearby structures.
5. Conduct inspections of rigging equipment and hoisting machinery before use, ensuring safety and proper operation specific to arboricultural tasks.
6. Describe the cycles to failure of gear and tree parts, emphasizing maintenance and safety.
7. Utilize various rigging techniques specific to arboriculture, such as natural crotches, false crotches, and tree-specific knots, to secure loads effectively during tree removals.
8. Compare and contrast butt tying, tip tying, and balancing techniques, explaining their applications in different tree rigging scenarios.
9. Explain and compare static and dynamic loads in the context of arboricultural rigging, and their implications for safe tree removal and equipment use.
10. Explain the importance of managing friction in arboricultural rigging operations and demonstrate methods to control it in the context of tree weight and movement.
11. Compare a variety of friction devices, e.g., block and tackle, friction savers, and their applications in tree rigging.
12. Discuss the criteria for selecting anchor points in rigging operations, ensuring tree stability and safety.
13. Use a Green Log Weight Chart to determine the weight of a given log accurately, adjusting for factors like moisture content and tree species.
14. Utilize rigging component charts specific to arboricultural tasks, such as lifting branches, removing trees, or transporting logs, to determine the proper type and size of devices required.
15. Calculate and apply appropriate sling angles in accordance with industry standards to ensure safe and effective lifting of tree limbs and other materials.
16. Use appropriate terminology to communicate effectively with the crane operator via headset or radio in the context of tree removal and rigging operations.
17. Use correct hand signals for collaborating with the crane operator during tree lifts and other rigging operations.
18. Follow visual instructions on posted signs to ensure safety in tree work zones and rigging areas.
19. Explain the role of chainsaw use during rigging operations, including considerations for load tension, cut placement, and climber safety.
20. Demonstrate ergonomic rigging principles to promote safety for both climbers and ground workers in tree removal scenarios.

## Floriculture and Greenhouse Management (Standards 16 – 25)

### Standard 16: Fundamentals of Floral Arrangement Construction

Students will design and construct floral arrangements using foundational design principles, appropriate materials, and professional techniques to ensure structural stability and visual appeal.

* Aligned Industry Recognized Credentials: Principles of Floral Design Certification

#### Skills:

1. Explain how floral designs from different historical periods influence contemporary designs, comparing a range of styles, identifying their key characteristics, and illustrating their impact on modern aesthetics and trends.
2. Examine how cultural trends and social media influence floral design, including multicultural practices, global styles, and the impact of platforms like Instagram and Pinterest on current trends.
3. Identify and implement the mechanics and techniques used in floral design construction, including selecting essential tools, materials, and methods necessary for creating effective floral arrangements.
4. Identify and apply sustainable floral design techniques, including the selection of eco-friendly materials and local sourcing of cut flowers, to create arrangements that minimize environmental impact while maximizing aesthetic appeal.
5. Select appropriate containers based on size, texture, shape, and color to ensure visual harmony and structural support in floral arrangements.
6. Compare and contrast assorted brands and types of floral foam, including specialty forms, devices, and eco-friendly options, such as biodegradable foam, to determine the best choices for specific floral designs.
7. Prepare floral foam for specific designs to maximize water retention and stability for the flowers.
8. Distinguish between types of adhesive products and their applications to choose the best options for securing floral components effectively.
9. Select the appropriate cutting tools for floral design work to ensure precision and safety during the preparation of materials.
10. Identify several types of picks and describe their uses to enhance the stability and presentation of floral arrangements.
11. Recognize varying gauges and forms of wire and demonstrate wiring and taping techniques to ensure durability and support in floral designs.
12. Categorize sizes, materials, and uses of ribbon, and construct bows using various sizes and types to add decorative flair and finish to arrangements.
13. Demonstrate different techniques, applications, and types of decorative wire to provide flexibility and creativity in design.
14. Examine new methods in design such as floral sculpture, installation art, or using unexpected materials (like metal or glass) in arrangements.

### Standard 17: Floral Selection and Post-Harvest Handling

Students will apply industry best practices to select, handle, and condition cut flowers and foliage, enhancing product quality and extending vase life for effective use in floral design.

* Aligned Industry Recognized Credentials: Principles of Floral Design Certification

#### Skills:

1. Use scientific names to identify the most common cut flowers including those on the National FFA Floriculture Career Development Event Plant List.
2. Explain the concept of vase life and its implications for selecting flowers in floral designs.
3. Explain the availability of cut flowers and foliage, including a range of color selections that can be utilized in arrangements.
4. Identify standard industry packing quantities for cut flowers and foliage, understanding how this affects distribution and sales.
5. Describe the steps and procedures for the handling of flowers from farm to market to ensure quality preservation.
6. Utilize inventory management software to monitor stock levels.
7. Monitor the quality of inventory regularly, identifying any issues such as wilting or spoilage, and follow protocols for handling and documenting damaged or expired products.
8. Identify the causes of premature flower senescence, including factors such as fungus, bacteria, and ethylene gas, and their impact on flower longevity.
9. Execute the steps and methods of flower conditioning to prepare flowers for optimal display and longevity.
10. Identify the advantages of using floral preservatives and pre-hydrating solutions in the care of cut flowers.
11. Analyze the importance of pH levels in water quality and their effects on the vase life of flowers.
12. Apply knowledge of refrigeration and sanitation practices to extend the life of cut flowers.
13. Implement specific floral conditioning techniques tailored for distinctive and delicate flowers and foliage.
14. Examine advancements in preservation techniques to extend the life of floral arrangements.
15. Explain the storing requirements for flowers and foliage, including appropriate temperature and humidity levels.
16. Choose suitable flowers for drying and identify the methods for preserving them for various applications.

### Standard 18: Principles of Floral Design and Arrangement Construction

Students will apply essential design principles and elements to create a variety of floral arrangements, utilizing appropriate materials and techniques while exploring different forms and color harmonies to achieve visually balanced compositions.

* Aligned Industry Recognized Credentials: Principles of Floral Design Certification

#### Skills:

1. Apply knowledge of balance, emphasis, focal point, harmony, rhythm, proportion, and scale in floral design.
2. Utilize elements of line, form, texture, and color in creating floral designs.
3. Examine the psychological impact of flowers on recipients, exploring how colors, types, and arrangements can convey emotions, such as joy, sorrow, love, and remembrance.
4. Examine the color wheel to understand color relationships, identify various color harmonies, and evaluate their application in floral designs to enhance visual impact and emotional resonance.
5. Utilize digital design tools and applications to create and visualize floral arrangements, incorporating features such as color matching, arrangement planning, and virtual simulations to enhance the design process.
6. Identify the twelve common floral design forms used in the industry: Oval, Inverted-T, Vertical, Asymmetrical Triangle, Horizontal, Hogarth’s Curve, Right Angle, Round, Crescent, Diagonal, Equilateral Triangle, and Fan.
7. Execute the four basic floral design forms: round, triangle, line, and horizontal.
8. Execute advanced floral design shapes used in the industry, including contemporary and Ikebana designs.
9. Select cut flowers and greens that are suitable for a variety of floral designs, evaluating their characteristics to enhance both the aesthetic appeal and the practicality of the design goals.
10. Identify the forms and shapes of flowers, e.g., mass, line, form, filler and explain their importance in creating balanced and visually appealing floral arrangements.
11. Utilize techniques of flower placement to achieve design principles and elements.
12. Identify the most commonly used cut flowers and foliage in modern floral design.
13. Demonstrate the proper techniques for creating well developed principles and elements of design for the flowers to wear design, e.g., boutonnieres, corsages, wristlet, circlet, or floral wreath headpiece.
14. Demonstrate proper wiring techniques for given flowers, such as clutch wiring, cross-pierce wiring, hairpin wiring, and insertion wiring.
15. Demonstrate the proper technique for using floral glue and other adhesive materials.
16. Select appropriate flowers and design single and multiple bloom bud vases.

### Standard 19: Floral Design for Holidays and Special Occasions

Students will be able to design and execute floral arrangements for a variety of holidays, special occasions, and cultural traditions, while managing inventory effectively and applying knowledge of the significance of each design element within the context of the event.

* Aligned Industry Recognized Credentials: Principles of Floral Design Certification

#### Skills:

1. Identify significant holidays and their associated floral arrangements, analyzing sales trends and seasonality to anticipate inventory needs, preventing overstock or stockouts.
2. Examine traditions of various cultures regarding special occasions and holiday floral needs, integrating these insights into design choices ensuring arrangements resonate deeply with clients and their guests.
3. Describe the process of special event consultations and accurately populate an order form to reflect client preferences and requirements.
4. Identify appropriate locations for floral design pieces at events to ensure optimal visibility and impact, and evaluate current floral event design trends, including large-scale installations, photo backdrops, ceiling treatments, and foam-free mechanics.
5. Distinguish between various forms of bridal bouquets (arm bouquet, clutch bouquet, hand-tied bouquet, colonial bouquet, cascading bouquet) and demonstrate the construction techniques for each.
6. Identify floral pieces used in matrimonial ceremonies, e.g., pews, altars, and receptions, guest tables, cake tables, ensuring a cohesive design throughout the event.
7. Demonstrate constructing wreaths using a variety of materials (evergreens, dried, and permanent materials) and properly attach decorations to ensure durability and aesthetic appeal.
8. Identify the types and significance of bereavement arrangements and specialty sympathy designs, and demonstrate techniques for creating them, including casket covers, standing sprays, baskets, wreaths, modern interpretations, and plant-based tributes.
9. Evaluate the use of permanent botanicals in floral design and demonstrate professional techniques for creating long-lasting arrangements that retain aesthetic quality over time, considering modern materials and consumer preferences.

### Standard 20: Interior Landscape Design

Students will be able to design, implement, and maintain interior landscapes that enhance indoor environments by strategically selecting and placing plants to meet aesthetic, functional, and environmental goals.

#### Skills:

1. Use scientific names to identify the most common indoor plants listed on the National FFA Floriculture Career Development Event Plant List, demonstrating accurate botanical knowledge.
2. Practice effective plant use in interior landscapes by assessing light, water, temperature requirements, and size, ensuring optimal placement and health of plants.
3. Identify and articulate the functions of plants used in interior locations, including aesthetic enhancement, air purification, psychological benefits, and contributions to biophilic design.
4. Utilize digital design tools to plan and implement an interior plantscape, applying the principles of design (balance, scale, harmony, and unity), creating an aesthetically pleasing and functional environment.
5. Evaluate the elements of an interior design, such as screens, living walls, and accent pieces, and analyze their effectiveness in enhancing the overall space.
6. Identify and describe the special care requirements for tropical and foliage plants, ensuring proper maintenance to promote growth and longevity.
7. Examine the use of SMART technologies, such as smart irrigation systems and plant care apps, to impact the efficiency of maintenance plans.
8. Develop a comprehensive maintenance schedule for interior plantscapes, including watering, fertilization, pruning, and pest control to ensure healthy plant growth.
9. Select and decorate appropriate indoor plants for specific uses, distinguishing between permanent and temporary indoor plants and ensuring design compatibility with the space.

### Standard 21: Greenhouse Structures, Systems, and Water Management

Students will evaluate greenhouse structures, systems, and technologies to optimize water management, sustainability, and plant growth in modern horticultural production.

#### Skills:

1. Evaluate types of greenhouse structures, such as Gothic arch, Quonset, Gutter-Connected, or Multi-Span, based on factors like size, orientation, ventilation, suitability for effective water management practices, and incorporation of advanced materials and technologies.
2. Identify and compare different manual and automatic watering systems, e.g., drip irrigation, ebb, and flood, and analyze their effectiveness in relation to the selected greenhouse design.
3. Identify construction materials and greenhouse coverings, e.g., polyethylene, glass, polycarbonate, and evaluate their pros and cons for various climates and specific applications.
4. Describe the uses and benefits of cold frames, hotbeds, growing rooms, and bulb cellars in modern production, highlighting their roles in extending growing seasons, optimizing plant growth, and enhancing storage conditions.
5. Evaluate shade materials and methods, discussing their effectiveness in managing light exposure.
6. Evaluate the use of LED grow lights and their efficiency and role in supplementing natural light, especially in growing rooms.
7. Calculate greenhouse heating requirements and compare modern heating systems, including energy-efficient options.
8. Summarize the benefits of ventilation and cooling, identifying modern methods such as evaporative cooling systems, pad-and-fan systems, fogging, and passive ventilation strategies.
9. Differentiate between types of greenhouse benches and arrangements for optimizing space and accessibility.
10. Calculate bench space requirements based on various pot sizes and arrangements.
11. Evaluate capillary mats and ebb-and-flow benches, discussing their effectiveness in water conservation and overall plant health management in modern greenhouse systems.
12. Analyze emerging trends in greenhouse technology and their potential impact on future developments in horticultural production, such as smart sensors, automated systems, and sustainable materials.

### Standard 22: Growing Media and Fertilizer in Greenhouse Production

Students will be able to apply knowledge of growing media and fertilizers while exploring innovative technologies and environmentally responsible methods to enhance plant health and improve production efficiency in greenhouse environments.

#### Skills:

1. Assess the selection and application of growing media and fertilizers in greenhouse production.
2. Evaluate different types of growing media, including organic and synthetic options such as rockwool and perlite/vermiculite blends, and assess their properties and suitability for hydroponic and greenhouse systems.
3. Identify the applications of soilless media and discuss their advantages in greenhouse settings.
4. Summarize the fertilizer requirements for various crops, including adjustments throughout the plant lifecycle.
5. Compare different forms of fertilizers (dry, liquid, controlled release) and their specific applications.
6. Monitor and manage salt levels in media, understanding the impacts of salinity on plant health.
7. Explore and apply modern nutrient delivery technologies, such as automated dosing systems and smart fertilizers, to calculate and adjust fertilizer application rates based on plant needs and growth stages.
8. Assess water quality and its impact on nutrient absorption, including methods to improve water quality.
9. Calculate the volume of media needed for various pot sizes, considering production efficiency.
10. Examine biostimulants, such as microbial and seaweed-based products, for their sources, types, and modes of action, particularly how these mechanisms influence crop production.

### Standard 23: Hydroponics and Advanced Technologies

Students will analyze and apply hydroponic techniques and technologies, including growing media, water quality management, and environmental monitoring, to enhance plant health and production.

#### Skills:

1. Compare hydroponic systems and growing media, evaluating their efficiency for various crops.
2. Identify crops suited for hydroponic cultivation and their specific growth needs.
3. Explain the nutritional needs of hydroponic crops, including sources and methods of nutrient delivery.
4. Calculate nutrient rates and volumes for hydroponic systems, understanding the importance of water quality.
5. Conduct a series of water quality tests (pH, EC, dissolved oxygen) on a hydroponic system and interpret the results to assess suitability for crop growth.
6. Assess various water recycling techniques suitable for hydroponics in floriculture, considering factors such as plant needs, system efficiency, cost implications, and environmental impact.
7. Evaluate existing real-time monitoring systems that utilize IoT devices for hydroponic setups focused on flowering plants.
8. Identify key environmental factors to monitor, e.g., pH, temperature, humidity, and analyze how these factors influence bloom quality and shelf life.
9. Explore the integration of hydroponic systems within vertical farming frameworks.
10. Analyze the potential of vertical farming to address challenges in urban floriculture and sustainability.
11. Analyze and evaluate the effectiveness of aquaponic systems in terms of sustainability, resource efficiency, and crop yield specifically for the cultivation of ornamental and flowering plants.

### Standard 24: Plant Propagation and Biotechnology

Students will apply and evaluate plant propagation techniques, integrating modern biotechnology, sustainable practices, and pest management strategies to enhance plant health and production efficiency.

#### Skills:

1. Explain environmental requirements for seed germination, focusing on moisture, temperature, and light.
2. Describe ideal germination media properties and their role in successful propagation.
3. Identify seed sowing methods suited for different seed sizes and production techniques.
4. Outline requirements for transplanting seedlings, including growth stages and environmental conditions.
5. Differentiate between cutting methods for asexual propagation (stem, leaf, and leaf bud cuttings).
6. Evaluate environmental conditions for successful cutting propagation, including moisture and temperature.
7. Demonstrate layering and division propagation techniques.
8. Discuss how biotechnology, including tissue culture, enhances plant propagation techniques and production efficiency by enabling rapid multiplication, improving disease resistance, and facilitating the propagation of challenging species.
9. Compare meristem culture and tissue culture methods, evaluating their applications in modern production, including their roles in disease prevention, genetic conservation, and rapid propagation of high-value crops.
10. Describe and demonstrate the conditions and techniques necessary for successful tissue culture, adhering to industry standards.
11. Discuss how genetic modifications and breeding programs are used to improve plant traits like disease resistance, flower color, and size in floriculture.
12. Investigate various sustainable practices in plant propagation, such as organic growing media, water conservation techniques, and eco-friendly pest management strategies.
13. Implement IPM strategies in the greenhouse setting, analyzing, and differentiating among biological, cultural, physical, and chemical pest management practices.
14. Identify common greenhouse pests, e.g., aphids, mites, whiteflies, analyze their life cycles and behaviors, and develop targeted management strategies that include the use of beneficial insects, organic pesticides, and cultural practices such as crop rotation and sanitation.
15. Examine prevalent greenhouse diseases, e.g., Botrytis, downy mildew, powdery mildew, and evaluate effective control methods, including fungicides and cultural practices.
16. Explore the roles of traditional plant breeding, marker-assisted selection, and genetic modifications in improving floriculture crops, emphasizing how these methods contribute to traits like disease resistance, flower longevity, and environmental adaptability.

### Standard 25: Greenhouse Crop Production

Students will apply principles of greenhouse crop production to effectively cultivate key ornamental and vegetable crops, integrating knowledge of plant requirements, management techniques, and market dynamics to enhance productivity and quality in a greenhouse environment.

#### Skills:

1. Identify and describe the production requirements for key greenhouse crops, including ornamentals and vegetables, considering factors like light, water, and nutrients.
2. Demonstrate best practices for transplanting plants at various growth stages, focusing on factors that contribute to successful establishment in a greenhouse environment.
3. Explain photoperiodism and distinguish between short-day, long-day, and day-neutral plants, and how these classifications affect crop management decisions.
4. Describe the lighting needs of greenhouse crops, including the role of supplemental lighting systems in optimizing growth and flowering.
5. Apply artificial lighting techniques in greenhouse settings to manage photoperiod for various crops, focusing on how these techniques influence flowering, fruiting, and overall plant growth**.**
6. Analyze how temperature influences plant growth and apply effective thermal management strategies to maintain optimal growing conditions in the greenhouse.
7. Utilize plant growth regulators (PGRs) effectively to manipulate growth patterns, enhancing crop quality and yield.
8. Implement automation and smart technologies in greenhouse settings, utilizing climate control systems, sensor technologies for monitoring plant health, and data analytics to optimize growth conditions, improve resource efficiency, and enhance overall crop quality.
9. Compare and contrast various methods of pinching and disbudding for controlling growth and improving aesthetic quality, emphasizing their application in crop production.
10. Summarize key factors influencing the selection of greenhouse crops for production, including market demand, growth requirements, and seasonal considerations.
11. Explain the dynamics of seasonal markets for greenhouse crops and develop strategies to optimize production schedules to meet market demands.

## Landscaping and Turf Management (Standard 26 – 34)

### Standard 26: Landscaping Design and Project Management

Students will be able to conduct thorough site analyses, use computerized design software, create precise estimates and proposals, and manage all phases of landscape projects, from design through implementation, ensuring projects are completed on time and within budget.

#### Skills:

1. Conduct a site analysis to inform the design process, evaluating factors such as topography, climate, and existing vegetation.
2. Utilize basic survey equipment to conduct site measurements for landscape design, including sketching dimensions, assessing topography, determining elevations, and identifying existing features to inform the landscape design layout.
3. Analyze the effects of sun, wind, moisture, and sound on the landscape.
4. Select appropriate plants based on site conditions and future use.
5. Utilize computerized design software to create professional-quality landscape designs that meet client specifications and enhance site functionality.
6. Convert site measurements into scale dimensions for accurate representation in design plans, ensuring that all elements are proportionate and visually accurate.
7. Use an Architect’s and Engineer’s scale ruler for precise calculations and to verify that scaled drawings correspond accurately to the physical site dimensions.
8. Calculate the square area of different sections of the site for planning purposes, providing essential data for material estimation and design layout.
9. Utilize industry-standard software to develop a comprehensive estimate and proposal for landscape projects, including both construction and maintenance jobs.
10. Identify and calculate all components required for an estimate, including materials, labor, equipment, subcontractor costs, disposal, and overhead, to ensure accurate project budgeting.
11. Determine appropriate markups and create a complete budget for the project.
12. Prepare and present a formal bid proposal that clearly outlines the project scope, costs, timelines, and the value of the proposed work, using professional language, visuals, and design plans to effectively communicate with stakeholders and potential clients.

### Standard 27: Hoisting and Rigging in Landscape

Students will be able to apply prior knowledge of site safety, equipment operation, and material handling to assist with hoisting and rigging tasks in landscaping, operate and maintain heavy equipment according to industry safety standards, and prepare for the Massachusetts Hoisting License exam.

* Aligned Industry Recognized Credentials: MA Hoisting Apprentice License

#### Skills:

1. Identify and describe the working parts of hoisting machinery and rigging equipment used in landscaping, including cranes, skid steer loaders, front-end loaders, and rigging components such as slings and pulleys, to ensure safe operating procedures.
2. Explain the function of modern personal protective equipment (PPE) technologies, including automatic safety harnesses, smart helmets, and wearable safety technology used in landscaping operations.
3. Accurately estimate the weight of materials, such as soil, heavy stones, or construction materials, being lifted to ensure safe handling and compliance with equipment limits.
4. Conduct a site inspection to assess the surrounding environment for potential hazards, such as power lines, unstable terrain, and nearby structures, specific to landscaping tasks.
5. Inspect rigging equipment and hoisting machinery before use to ensure safety and proper operation, emphasizing machinery maintenance and proper setup.
6. Describe the cycles to failure of gear and materials in landscaping tasks, emphasizing maintenance and safety protocols for heavy machinery.
7. Utilize various rigging techniques specific to landscaping, such as securing loads for tree planting, heavy material placement, and landscape features like large boulders or stones.
8. Safely operate and maintain landscape construction equipment, including skid steer loaders, front-end loaders, and cranes, in accordance with safety standards and manufacturer’s specifications.
9. Perform basic engine maintenance on construction equipment, including checking filters, fuel levels, grease points, and making routine adjustments to ensure optimal performance.
10. Identify and explain the key components of skid steer loaders and front-end loaders, understanding their functions and maintenance needs for effective operation.
11. Communicate effectively with operators using appropriate terminology via headsets or radios during rigging and heavy equipment operations.
12. Use correct hand signals for collaborating with operators during lifts and other rigging operations, ensuring safety and efficiency.
13. Follow visual instructions on posted signs to ensure safety in landscaping work zones and rigging areas.
14. Demonstrate ergonomic principles in rigging to promote safety for both operators and ground workers during landscaping and construction operations.

### Standard 28: Landscape Construction

Students will be able to evaluate landscape construction plans and make informed decisions related to site development, drainage, soil preparation, and integration of irrigation systems, while safely operating equipment for project installation.

#### Skills:

1. Read and interpret landscape site plans, identify and explain key features, such as planting areas, hardscape materials, and grading changes.
2. Utilize modern construction equipment, such as levels, transits, measuring wheels, and digital measuring tools, to ensure accuracy in the execution of the designed project.
3. Demonstrate surveying existing grades (i.e., slope or elevation of land), and recommend corrective actions if needed for landscape design, irrigation, and drainage.
4. Analyze survey data to develop a site development plan that addresses topography, drainage solutions, soil management strategies, and appropriate irrigation types, ensuring optimal conditions for landscape installation.
5. Identify current utility locations and potential hazards, ensuring safety and compliance during construction.
6. Identify and describe site preparation activities, including land clearing, grading, and excavation, focusing on proper soil preparation and drainage to establish a solid foundation for landscaping features.
7. Assess the water requirements of a landscape to ensure adequate irrigation planning and implementation.
8. Apply site drawings to calculate quantities of materials needed, e.g., soil, mulch, pavers, for landscape projects.
9. Select appropriate materials for landscaping projects by evaluating factors such as durability, aesthetic appeal, and environmental sustainability, ensuring alignment with project proposal and design plans.
10. Differentiate between hardscape and softscape materials, selecting suitable options for each category, including elements like stone, pavers, plants, and soil types, to enhance the overall landscape design.
11. Identify and describe various walkway materials and systems, e.g., pavers, bluestone, natural stones, concrete, and their applications in landscape construction.
12. Apply basic math skills, including the use of fractions and decimals, to accurately measure, calculate, and cut materials such as blocks and pavers for landscape features, e.g., sidewalks, retaining walls, ensuring precise fit and alignment according to project specifications.
13. Demonstrate installation of a walkway, ensuring proper techniques and materials are used.
14. Identify, describe, and install different retaining wall materials and systems, e.g., interlocking concrete, wet stone, dry stone, and their structural benefits.
15. Identify, describe, and install various water features and systems, e.g., ponds, fountains, waterfalls, and their role in landscape design.
16. Identify the primary features of an irrigation system, understanding its components and functions.
17. Compare and contrast common types of irrigation systems, e.g., drip, impact, rotary, temporary, to determine general suitability for a site during the construction planning phase, considering layout, plant types, and project scope.
18. Evaluate how different soil types influence irrigation choices and assess the impact of hardscape features on water distribution within the landscape.

### Standard 29: Irrigation System Design, Installation, and Maintenance

Students will be able to design, install, maintain, and troubleshoot landscape irrigation systems, applying principles of water efficiency, system optimization, and sustainable resource management to ensure reliable and environmentally responsible performance.

* Aligned Industry Recognized Credentials: Certified Irrigation Technician (CIT)

#### Skills:

1. Select and configure appropriate irrigation systems based on detailed analysis of components and functions, e.g., piping, emitters, sprinklers, evaluating site-specific conditions such as soil type, slope, water pressure, and plant needs.
2. Design and install irrigation systems according to plans, ensuring uniform coverage and incorporating sustainable techniques such as rainwater harvesting and xeriscaping.
3. Measure, cut, and join irrigation piping using proper tools and techniques to ensure leak-free, durable connections.
4. Compare piping materials, e.g., PVC, poly, copper, for pressure tolerance, durability, and environmental suitability.
5. Identify types of valves used in irrigation systems, and demonstrate installation, troubleshooting, and maintenance procedures for valve assemblies and enclosures.
6. Install and maintain backflow prevention devices, e.g., pressure vacuum breakers, double-check valves, in compliance with safety regulations.
7. Apply basic hydraulic principles, including flow rate, pressure regulation, and friction loss, to irrigation system design and diagnostics.
8. Use pressure gauges and flow meters to verify system performance and diagnose issues such as inconsistent pressure or flow.
9. Differentiate between static and dynamic pressure and explain how pressure readings influence system efficiency and component selection.
10. Record and interpret flow meter readings to evaluate system performance against manufacturer specifications.
11. Use friction loss charts to select proper pipe sizes and layouts and explain how friction loss affects valve and system operation.
12. Analyze how environmental and soil factors impact irrigation performance, and troubleshoot issues such as uneven coverage, runoff, or water waste.
13. Configure and troubleshoot irrigation control systems, including mechanical, hydraulic, and electronic controllers, sensors, and valves.
14. Perform basic controller functions, including zone programming, resetting, diagnostics, and error interpretation.
15. Replace controller components as needed, following manufacturer specifications and safety guidelines.
16. Test solenoids and transformers for voltage and resistance, and match replacement parts to system specifications.
17. Determine appropriate wire types and sizes based on voltage, distance, and load; identify burial depths in compliance with electrical codes.
18. Perform field wiring tasks, including valve locating, wire tracking, splicing, and waterproof sealing using appropriate tools and materials.
19. Identify and explain the function of drip irrigation components, including tubing, filters, pressure regulators, and emitters.
20. Determine appropriate drip system layout, filtration, and pressure requirements, and perform routine maintenance and repairs.
21. Identify common irrigation system sensors, e.g., rain, freeze, soil moisture, explain their operation, and perform basic installation, maintenance, and replacement.
22. Perform seasonal and routine system maintenance, including inspection, cleaning, calibration, and controller scheduling adjustments.
23. Diagnose and repair system malfunctions, such as faulty valves, clogged emitters, broken lines, or inconsistent pressure.
24. Assess situations where hand-watering is appropriate and apply techniques that support plant health while minimizing water use.

### Standard 30: Plant Selection and Installation

Students will be able to select and install plants that support sustainable, resilient landscapes, considering soil conditions, water availability, pest resistance, and prioritizing native and climate-adapted species.

#### Skills:

1. Analyze and categorize common bulbs, e.g., daffodil, tulip, gladiola, lily of the valley, based on their growing conditions and seasonal traits, justifying their selection for specific landscape designs.
2. Evaluate various annuals, e.g., impatiens, geraniums, marigolds, for their aesthetic appeal, environmental impact, and maintenance requirements, recommending the best options for different landscape contexts.
3. Assess the growth cycles and environmental needs of key perennials, e.g., Hemerocallis, Rudbeckia, Delphinium, and determine their suitability for specific landscape installations.
4. Examine common deciduous shrubs, e.g., Forsythia, Viburnum, and Lilac, for their ornamental characteristics and ecological contributions, such as soil stabilization and wildlife support.
5. Investigate the functional and aesthetic contributions of needled evergreen shrubs, e.g., Taxus, Juniper, within various landscape settings, proposing optimal planting strategies that enhance year-round interest and provide privacy or windbreaks.
6. Compare and contrast coniferous trees, e.g., Pine, Spruce, Fir, in terms of growth habits and environmental adaptations, providing recommendations for landscape integration.
7. Evaluate the seasonal changes and growth requirements of deciduous trees, e.g., Maple, Oak, Birch, justifying their use in landscape designs.
8. Analyze the unique features and benefits of deciduous-coniferous trees, e.g., larch, dawn redwood, bald cypress, for diverse landscape applications.
9. Apply effective soil preparation strategies that enhance soil health and nutrient availability and optimize pH levels for diverse plant types considering modern techniques like soil amendments (compost, biochar) and precision soil testing to create ideal conditions for plant establishment.
10. Apply organic practices and integrate sustainable solutions such as cover cropping and no-till methods to reduce soil erosion and improve water retention.
11. Implement the installation of bedding plants and groundcovers, e.g., annuals, perennials, incorporating modern planting technologies, such as hydro-mulching, biodegradable planting mats, or automated irrigation systems to enhance establishment rates and reduce maintenance.
12. Plan the installation of trees and shrubs with attention to depth, spacing, and overall landscape integration, ensuring successful establishment and growth, while using native and climate-adapted species to create sustainable, low-maintenance landscapes.
13. Evaluate various transplanting methods, such as B&B, bare root, containerized, rootball shrink-wrap, and soil stabilizers, to minimize transplant shock and enhance root development, based on plant types and environmental conditions.
14. Implement current industry-approved techniques for staking and guying trees, ensuring stability and proper growth.
15. Utilize proper techniques for staking and tying flowering plants, such as plant ties, cages, or trellises, assessing the impact on their growth and aesthetics.

### Standard 31: Landscape Maintenance

Students will be able to apply landscape maintenance practices to support plant health, perform seasonal irrigation system care, and troubleshoot routine system issues to ensure landscape vitality and sustainable resource use.

#### Skills:

1. Conduct ongoing maintenance for bedding plants, including tasks such as watering, fertilizing, deadheading, and pest management, promoting plant health and vibrancy.
2. Identify common signs of plant stress such as yellowing leaves, wilting, poor growth, or pest infestations, and propose innovative solutions for mitigating transplant shock and recovery, using biostimulants, adjusting watering schedules, or enhancing soil health through aeration or organic amendments.
3. Implement and maintain an Integrated Pest Management (IPM) program, monitoring plant health regularly to detect early signs of pest activity.
4. Assess and adjust landscape maintenance practices based on local climate conditions, including temperature, precipitation patterns, and seasonal variations.
5. Assess the need for pruning based on factors such as plant health, aesthetics, safety, disease control, and timing, and apply techniques that promote healthy growth and maintain landscape integrity.
6. Demonstrate the proper use and maintenance of various pruning tools, including bypass pruners, anvil pruners, loppers, and hand saws to ensure optimal cutting performance and longevity.
7. Apply thinning techniques to improve plant structure, air circulation, and sunlight penetration.
8. Use restorative pruning techniques to rejuvenate overgrown, neglected, or underperforming plants.
9. Perform corrective pruning to address structural issues, such as crossing branches, weak limbs, or overcrowded growth.
10. Execute basal pruning to remove basal shoots, promoting healthy new growth and maintaining plant vitality.
11. Apply winter protection techniques, e.g., mulching, and anti-desiccants, thoughtfully evaluating their effectiveness for plant survival during harsh conditions.
12. Compare and contrast advanced pruning techniques, such as espalier, topiary, bonsai, and pollarding, evaluating their distinct applications, benefits, and limitations in landscape design, as well as their impact on aesthetic and ecological considerations.
13. Evaluate the impact of corrective pruning on plant health, structural integrity, and overall aesthetic appearance.
14. Analyze potential water runoff issues and restrictions, assessing their implications for landscape health and proposing sustainable solutions.

### Standard 32: Power Tool Operation, Maintenance, and Safety

Students will be able to safely operate, maintain, and troubleshoot power tools, including mowers, trimmers, chainsaws, and backpack blowers, following industry and OSHA safety standards.

#### Skills:

1. Identify and describe the functions of various commercial mower types, including, walk-behind mowers, riding mowers, rotary mowers, reel mowers, and flail mowers.
2. Operate and maintain a commercial mower including basic engine maintenance, e.g., filters, fuels, grease points, and routine adjustments.
3. Perform blade maintenance, e.g., inspection for wear and defects, changing, sharpening, and balance.
4. Safely operate and maintain various models of commercial string line trimmers, adjusting settings such as string length, speed, and cutting angles for optimal performance in different landscape conditions.
5. Identify potential safety hazards associated with trimmer use, including flying debris, the risk of entanglement, operator fatigue, and improper ergonomics, and take preventive measures to ensure safe operation in compliance with industry and OSHA standards.
6. Demonstrate how to prepare a 2-cycle fuel mix at the correct ratio, following the manufacturer's guidelines for each type of equipment, to ensure proper engine operation and prevent damage.
7. Conduct basic engine maintenance, including checking and replacing air and fuel filters, refueling, and making necessary adjustments to keep the engine running efficiently.
8. Perform basic maintenance of the trimmer’s power head, including replacing and adjusting the cutting string, lubricating moving parts, and ensuring proper functionality.
9. Identify signs of plant damage caused by improper string trimmer use, such as bark stripping, scalping, or unintended cutting of delicate plants.
10. Safely use a commercial backpack blower according to current industry and OSHA standards, including proper starting, operating, and shutting down procedures.
11. Inspect and maintain engine components, e.g., air filters, fuel system, idle, and throttle adjustments, to ensure optimal performance.
12. Identify potential risks associated with the backpack blower, such as engine overload, fuel spills, and noise exposure, and mitigate them using proper techniques and safety gear.
13. Identify and label key components of a chainsaw, e.g., bar, chain, throttle, sprocket, air filter, etc.
14. Explain kickback and reactive forces, describing how they occur, their potential dangers, and methods to prevent and manage them.
15. Explain why chaps, hard hats, ear protection, and appropriate attire, e.g., long pants and boots, are essential when using a chainsaw.
16. Demonstrate proper chainsaw operation, including the leg lock technique for stabilizing the chainsaw during starting.
17. Safely and correctly execute the ground start procedure, ensuring safe operation according to industry and OSHA standards.
18. Inspect and maintain key components of the chainsaw, including the air filter, chain, bar, sprocket, and fuel system, ensuring all parts are clean, in good working condition, and properly lubricated.
19. Identify and operate modern battery-powered power tools, such as mowers, trimmers, and blowers, discussing their advantages and challenges in terms of performance, battery life, and environmental benefits.

### Standard 33: Turfgrass Management

Students will be able to manage turfgrass in various environments, including residential lawns, athletic fields, and golf courses, by applying industry-standard practices, modern technologies, and sustainable methods to optimize turf health, performance, and environmental sustainability.

#### Skills:

1. Classify and describe the major parts of a typical turfgrass plant, including roots, shoots, leaves, and seed heads.
2. Analyze the three growth habits of turfgrasses, e.g., bunch, spreading, and stoloniferous, and their implications for turf management.
3. Evaluate factors affecting turfgrass growth, including environmental, cultural, and biological influences.
4. Distinguish between cool-season and warm-season grasses, assessing their growth patterns, characteristics, and environmental preferences.
5. Identify and assess key factors influencing turfgrass quality, such as soil health, water, light, and maintenance practices.
6. Select and implement appropriate seeding techniques, e.g., hand seeding, slice seeding, hydroseeding, and overseeding, based on turfgrass type and environmental conditions.
7. Install sod using proper techniques, ensuring correct soil preparation, placement, and watering requirements.
8. Evaluate and apply turf growth regulators and wetting agents, explaining their roles in managing turf health and water retention.
9. Analyze the effects of thatch on turfgrass health, including both beneficial and detrimental aspects, and recommend management strategies.
10. Explain watering requirements for both newly planted and established turf, adapting techniques to weather and growth stages.
11. Assess mowing requirements based on turfgrass species, growing conditions, and aesthetic or functional needs for different turf areas, e.g., golf courses, athletic fields, residential lawns.
12. Identify common broadleaf and grass weeds in turf, such as dandelions, crabgrass, and other invasive species, and assess their impact on turf health.
13. Diagnose common turfgrass insects and the types of damage they cause, including grubs, chinch bugs, and others.
14. Identify common turf pathogens (fungal, bacterial, viral) and their associated damage to turfgrass.
15. Design pest management strategies, incorporating cultural, biological, and chemical controls, with consideration for Integrated Pest Management (IPM).
16. Assess the impact of environmental stressors, e.g., drought, compaction, on turf quality, and identify solutions to mitigate damage.
17. Identify and operate turf application equipment, such as spreaders, hand sprayers, boom sprayers, and fertigators, demonstrating proper use and calibration.
18. Determine fertilizer requirements based on soil testing, turfgrass type, and seasonal needs, explaining nutrient cycles and deficiencies.
19. Design fertilization programs for different turf areas, including residential lawns and specialty areas such as athletic fields and golf course greens.
20. Calibrate and apply fertilizers and pesticides using sprayers and spreaders, ensuring accuracy, and minimizing environmental impact.
21. Implement sustainable turfgrass management practices, including water conservation techniques, Integrated Pest Management (IPM), and the use of organic or slow-release fertilizers to minimize environmental impact and enhance turfgrass health.
22. Apply data-driven turfgrass management techniques, utilizing soil testing, turf diagnostics, and performance data to optimize maintenance practices and ensure healthy, sustainable turfgrass growth.

### Standard 34: Turfgrass Management for Specialty Surfaces

Students will apply the principles of turfgrass management for specialty areas, including golf course greens, tees, fairways, sports fields, and other high-performance surfaces, focusing on the unique turfgrass requirements, maintenance practices, and technologies needed to optimize performance, health, and sustainability.

#### Skills:

1. Identify and differentiate between various types of sports fields, e.g., baseball, football, soccer, and assess the specific turfgrass requirements for each type of athletic field.
2. Evaluate and analyze turfgrass management practices for specialty areas on a golf course, including greens, tees, fairways, roughs, bunkers, and hazards and focusing on factors such as wear resistance, soil health, irrigation, growth patterns, seasonal care, and turfgrass adaptability to environmental conditions.
3. Identify and evaluate turfgrass varieties suitable for specific conditions, e.g., shade, sun, drought tolerance, on sports fields and golf courses, considering environmental adaptability, turfgrass needs, and regional climate factors.
4. Survey and design athletic fields, citing dimensions and layout for various sports, ensuring proper turfgrass selection and the incorporation of effective maintenance techniques.
5. Identify and explain the key soil requirements for USGA-standard putting greens, including the rootzone mix (sand and organic matter), soil texture (sand content), drainage capabilities, bulk density, soil pH, and the layered construction approach (subgrade, drainage, and rootzone layers).
6. Explore and describe modern technologies, such as soil sensors, moisture mapping systems, and other precision tools, used to enhance the maintenance and performance of USGA-standard putting greens.
7. Incorporate sustainable practices into turfgrass management for sports fields and golf courses, focusing on water conservation, eco-friendly pest control, and reducing chemical use to promote long-term turf health.
8. Understand and apply technology in turfgrass management, including the use of diagnostic tools, e.g., turf health sensors, soil testing equipment, data analysis, e.g., soil sensors, climate monitoring systems, and GPS-based systems for efficient irrigation, pest management, and monitoring turf health.

## Employability Standards

### Standard 35: Employability Skills

Students will demonstrate professional communication, critical thinking, problem-solving, professionalism, teamwork, and collaboration across various horticulture fields.

#### Skills:

1. Demonstrate effective communication and interpersonal skills to provide exceptional customer service in the horticulture sector, engaging with clients, suppliers, and colleagues through face-to-face interactions, phone calls, written communication, and digital platforms, ensuring clear and informative exchanges.
2. Demonstrate active listening by giving full attention to conversations with colleagues, clients, and stakeholders in horticulture-related activities, asking relevant questions to clarify needs and providing thoughtful responses in a timely manner.
3. Demonstrate the ability to facilitate meetings for project teams in horticulture, ensuring project goals are met by organizing progress updates, discussing challenges, and encouraging constructive feedback from team members.
4. Analyze complex issues within the horticulture field, e.g., pest management, sustainable farming practices, crop optimization, using critical thinking and problem-solving techniques to propose effective solutions while considering environmental and economic impacts.
5. Collaborate effectively in multi-disciplinary teams within the horticulture sector, coordinating with agronomists, landscapers, and other horticultural experts to achieve common objectives in areas such as plant management, landscape design, and sustainable practices.
6. Apply time management techniques in agricultural horticulture settings, prioritizing tasks such as planting, maintenance schedules, or nursery operations, to meet deadlines and maintain consistent workflow in seasonal cycles.
7. Demonstrate ethical behavior and adherence to safety and environmental standards in all agricultural horticulture activities, ensuring compliance with regulations for pesticide use, sustainable farming practices, and workplace safety.
8. Demonstrate leadership skills by motivating and guiding teams in agricultural horticulture projects, fostering a positive work environment, setting clear goals, and resolving conflicts to ensure team success and high-quality outcomes.

## Entrepreneurship Standards

### Standard 36: Entrepreneurship

Students will be able to identify entrepreneurial opportunities and evaluate the value proposition of business ownership across various sectors of the horticulture industry.

#### Skills:

1. Evaluate the licensing, regulatory, and tax implications of self-employment and business ownership in various sectors of the horticulture industry and compare these factors to the implications of W-2 employment.
2. Understand current job trends, skill requirements, and potential areas of growth within the modern horticulture industry.
3. Evaluate the role of e-commerce, online marketplaces, and digital sales platforms in growing horticultural businesses and develop strategies for effectively selling products and services online.
4. Assess the impact of technological advancements on business opportunities and strategies in the horticulture industry, focusing on the integration of new tools, software, and diagnostic equipment, and how these innovations can enhance efficiency and drive growth.

## Digital Literacy Standards

### Standard 37: Digital Literacy

Students will demonstrate digital literacy skills in horticulture, including the use of diagnostic software, data management, technical documentation, and digital communication to effectively carry out maintenance and management tasks in modern horticultural practices.

#### Skills:

1. Demonstrate effective electronic written and oral communication, as well as collaboration with team members, customers, and suppliers, including conducting virtual consultations with clients.
2. Utilize online resources, forums, and troubleshooting software to diagnose and solve technical issues related to horticultural equipment, plant health, irrigation systems, and other aspects of modern horticultural practices.
3. Utilize digital tools and software for business management, including project management platforms, inventory management systems, and accounting software tailored to small businesses in the horticulture industry.
4. Analyze and interpret data from digital tools and sensors, e.g., soil moisture sensors, climate data, plant health monitors, to make informed decisions about plant care, irrigation, and resource management.
5. Utilize digital tools to track sustainability efforts, such as water usage, energy consumption, and carbon footprint, to optimize resources and improve environmental impact in horticultural practices.