# Agricultural and Environmental Systems Career Field

## Landscape Hardscapes

**Subject Code: 010640**

**Outcome & Competency Descriptions**

**Course Description:**

Students will learn skills in constructing and installing hardscape features in a landscape. Topics include basic principles of building and implementing designs drawn and drafted from computer-aided designs and blueprints. Students will install artificial lighting, water systems, decks and creative concrete features on job sites. Throughout the course, business management practices, employability skills, and safety procedures will also be emphasized.

**Strand 1.**  **Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.1. Employability Skills**

Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.1. Identify the knowledge, skills and abilities necessary to succeed in careers.

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure and experience.

1.1.3. Develop a career plan that reflects career interests, pathways and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations and organized labor and use networking techniques to develop and maintain professional relationships.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, resumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability and responsibility and demonstrate associated behaviors in fulfilling personal, community and workplace roles.

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

1.1.8. Identify the correlation between emotions, behavior and appearance and manage those to establish and maintain professionalism.

1.1.9. Give and receive constructive feedback to improve work habits.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.

1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits and abusive behavior.

**Outcome: 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.1. Extract relevant, valid information from materials and cite sources of information.

1.2.2. Deliver formal and informal presentations.

1.2.3. Identify and use verbal, nonverbal and active listening skills to communicate effectively.

1.2.4. Use negotiation and conflict-resolution skills to reach solutions.

1.2.5. Communicate information (e.g., directions, ideas, vision, workplace expectations) for an intended audience and purpose.

1.2.6. Use proper grammar and expression in all aspects of communication.

1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.

1.2.8. Identify the strengths, weaknesses and characteristics of leadership styles that influence internal and external workplace relationships.

1.2.9. Identify advantages and disadvantages involving digital and/or electronic communications (e.g., common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity).

1.2.10. Use interpersonal skills to provide group leadership, promote collaboration, and work in a team.

1.2.11. Write professional correspondence, documents, job applications and resumés.

1.2.12. Use technical writing skills to complete forms and create reports.

1.2.13. Identify stakeholders and solicit their opinions.

1.2.14. Use motivational strategies to accomplish goals.

**Outcome: 1.3. Business Ethics and Law**

Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.

**Outcome: 1.4. Knowledge Management and Information Technology**

Demonstrate current and emerging strategies and technologies used to collect, analyze, record and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).

1.4.2. Select and use software applications to locate, record, analyze and present information (e.g., word processing, e-mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to the industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure and monitor business records.

1.4.6. Use an electronic database to access and create business and technical information.

1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

**Outcome: 1.6. Business Literacy**

Develop foundational skills and knowledge in entrepreneurship, financial literacy and business operations.

**Competencies**

1.6.1. Identify business opportunities.

1.6.2. Assess the reality of becoming an entrepreneur, including advantages and disadvantages (e.g., risk versus reward, reasons for success and failure).

1.6.3. Explain the importance of planning your business.

1.6.5. Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments and interdepartmental interactions.

1.6.6. Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry.

1.6.7. Identify the effect of supply and demand on products and services.

1.6.8. Identify the features and benefits that make an organization’s product or service competitive.

1.6.9. Explain how the performance of an employee, a department and an organization is assessed.

1.6.11. Describe how all business activities of an organization work within the parameters of a budget.

**Outcome: 1.8. Operations Management**

Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.

**Competencies**

1.8.2. Select and organize resources to develop a product or a service.

1.8.5. Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN).

1.8.6. Identify the advantages and disadvantages of carrying cost and Just-in-Time (JIT) production systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability.

**Outcome: 1.9. Financial Management**

Use financial tools, strategies and systems to develop, monitor and control the use of financial resources to ensure personal and business financial well-being.

**Competencies**

1.9.1 Create, analyze and interpret financial documents (e.g., budgets, income statements).

**Outcome: 1.10. Sales and Marketing**

Manage pricing, place, promotion, packaging, positioning and public relations to improve quality customer service.

**Competencies**

1.10.1. Identify how the roles of sales, advertising and public relations contribute to a company’s brand.

1.10.2. Determine the customer's needs and identify solutions.

1.10.3. Communicate features, benefits and warranties of a product or service to the customer.

1.10.4. Identify the company policies and procedures for initiating product and service improvements.

1.10.5. Monitor customer expectations and determine product/service satisfaction by using measurement tools.

1.10.6. Discuss the importance of correct pricing to support a product’s or service’s positioning in the marketing mix.

**Outcome: 1.12. Site and Personal Safety Procedures**

Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action.

**Competencies**

1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.

1.12.2. Interpret safety signs and symbols.

1.12.4. Describe how working under the influence of drugs and alcohol increases the risk of accident, lowers productivity, raises insurance costs and reduces profits.

1.12.5. Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits.

1.12.6. Identify procedures for the handling, storage and disposal of hazardous materials.

1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.

1.12.8. Identify safety hazards and take corrective measures.

1.12.9. Identify, inspect and use safety equipment appropriate for the task.

1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.

1.12.13. Demonstrate the proper use of American National Standards Institute (ANSI) hand signals.

**Strand 4.**  **Power Systems**

Learners apply principles of tool use, power transmission, hydraulics, two- and four-stroke cycle combustion, heating and cooling, exhaust, ignition, starting and charging, steering and lubrication systems to operate, to maintain or repair equipment.

**Outcome: 4.1. Tool, Stationary and Mobile Equipment Maintenance**

Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

**Competencies**

4.1.1. Inspect, clean, maintain and perform preventative maintenance on equipment.

4.1.2. Identify types of hand tools, power tools and equipment and describe their functions.

4.1.3. Ensure the presence and functionality of safety equipment.

4.1.4. Identify potential hazards and limitations related to the use of equipment.

4.1.5. Maintain organization, and cleanliness of facilities, machinery, equipment and tools for safety and appearance.

4.1.6. Inspect and service electrical systems and components.

4.1.7. Inspect for fluid leakage, fluid levels and the condition of fluids.

4.1.8. Inspect, clean, lubricate, and adjust equipment for safe operation.

4.1.9. Select fluids, maintain fluid levels and replace system filters per original equipment manufacturer (OEM) specification.

4.1.10. Inspect and maintain fluid conveyance and storage components.

4.1.11. Identify and maintain accuracy of tooling, machinery, and equipment when performing preventive maintenance and repairs.

4.1.12. Compare alternative sources of power equipment.

**Outcome: 4.2. Equipment Operations**

Operate and maintain mechanical equipment and power systems.

**Competencies**

4.2.1. Follow original equipment manufacturer (OEM) recommended operating procedures and adjustment specifications as found in the operator's manual.

4.2.2. Differentiate among the functions, limitations and proper use of equipment, equipment controls and instrumentation.

4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.

4.2.4. Perform appropriate start-up, operating and shut-down procedures.

4.2.5. Select and operate equipment and attachments needed to complete the task per the original equipment manufacturer (OEM) operator's manual.

**Strand 5.**  **Elements of Production**

Learners apply principles of practice related to the management and maintenance of food, agriculture and natural resources systems.

**Outcome: 5.1. Electrical Theory**

Interpret and apply electrical and electronic principles and theories.

**Competencies**

5.1.1. Read and interpret wiring diagrams and symbols.

5.1.6. Compare and contrast conductors and insulators.

5.1.7. Differentiate the relationships among voltage, current, resistance and power in circuits and understand the basics of transformers.

5.1.8. Measure the amperage of AC and DC electrical systems and system components.

5.1.9. Calculate voltage, current, resistance, impedance and power in circuits using Ohm’s Law, Kirchhoff's Law and Watt’s Law.

5.1.10. Describe the purpose of grounding and common methods used for grounding.

5.1.11. Describe the uses of series, parallel and series-parallel circuits.

5.1.12. Use a digital multimeter to determine voltage, current, frequency and phase.

**Outcome: 5.2. Structural Electrical Circuits**

Describe features of an electrical schematic that illustrates a wiring system and interpret and install the design.

**Competencies**

5.2.1. Describe over-current protective devices and their functions.

5.2.3. Map circuits and label the service panel directory to reflect devices installed on each circuit.

5.2.4. Calculate service requirements for an electrical installation and evaluate for safe capacity.

5.2.5. Identify types of cable, conduit, boxes, switches, outlets and other common wiring devices.

5.2.6. Identify fasteners, anchors and fire stop systems.

5.2.7. Select materials and lay out rough-in wiring runs according to specifications, drawings and code requirements.

5.2.8. Select and install lighting technologies and systems.

5.2.9. Make conductor terminations and connect appliances to circuits.

5.2.10. Identify and apply basic troubleshooting with electrical systems and circuits.

**Outcome: 5.3. Design and Estimate**

Plan and design a basic site plan for a desired outcome.

**Competencies**

5.3.1. Identify and interpret symbols, drawings, prints, and blueprints.

5.3.2. Apply proportional reasoning and indirect measurement techniques.

5.3.3. Complete a site inventory and analysis, including physical conditions, code and utilities requirements and the environmental impact.

5.3.4. Develop a program list, including intended use, budget, economics, customer wants and needs and maintenance.

5.3.5. Identify and apply the principles of balance, proportion, scale, focal point, emphasis, rhythm, harmony and unity to create a design.

5.3.6. Identify and apply the elements of line, function, form, texture and color to create a design.

5.3.7. Identify and apply design, organizational, and spatial principles into a design.

5.3.8. Calculate the space requirements and compute various attributes, including length, angle measurement, surface area and volume.

5.3.9. Identify construction documents, common scales, specifications and materials used in construction or fabrication.

5.3.10. Identify material, inputs and equipment needs based on availability to calculate costs in production or application.

5.3.11. Establish the sequential steps of construction and installation.

**Outcome: 5.4. Surveying and Mapping**

Perform surveying procedures to construct a site plan.

**Competencies**

5.4.1. Identify civil drafting symbols and abbreviations.

5.4.2. Interpret maps, topographic site plans, deeds and aerial or satellite imagery for site planning.

5.4.3. Perform site measurements.

5.4.4. Integrate map and surveying data into geographic information system (GIS) or computer aided design (CAD) software.

5.4.5. Identify topographical and existing features of areas, including property lines, benchmarks, utilities, streets and setbacks, on survey maps, parcel maps and plats.

**Outcome: 5.6. Construction**

Follow architectural plans to construct and repair simple outdoor structures and minor building additions.

**Competencies**

5.6.1. Compare and contrast the structural properties, grades and types of construction materials.

5.6.2. Lay out, cut, smooth, shape and bore construction materials.

5.6.3. Lay out, cut and install decks and floors.

5.6.4. Lay out, cut, assemble and brace framing components.

5.6.5. Lay out, cut and install stairs and steps.

5.6.9. Install glass, rigid plastic panels or film plastic.

5.6.10. Install and repair draft stops, weather stripping, thermal insulation and vapor barriers.

5.6.11. Analyze a surface’s condition and select and apply abrasives and fillers.

5.6.12. Contrast surface coatings and apply under appropriate environmental conditions.

5.6.13. Review and apply facility and fencing options in a production setting.

**Outcome: 5.7. Brick, Block and Concrete**

Following a design layout and install a structure using bricks, pavers, blocks, stone or concrete.

**Competencies**

5.7.1. Describe the physical properties of bricks, pavers, mortar, blocks and concrete.

5.7.2. Explain the chemical reactions within and between materials.

5.7.3. Describe air ratio and slump.

5.7.4. Perform layout and elevations using measurements to scale.

5.7.5. Mix, place and finish bricks, pavers, blocks, stone or concrete.

5.7.6. Install cut bricks, pavers, blocks, stone or concrete with or without adhesives.

5.7.7. Install footers, lintels, sills, poured walls, floors and accessories per manufacturer's specifications.

5.7.8. Install gravel and sand pads.

5.7.9. Layout and construct forms and reinforce them using steel, wire and other materials.

5.7.10. Layout and install anchor bolts in concrete.

5.7.11. Install joints in concreate (e.g. expansion, saw cut vs tooled joint).

5.7.12. Select curing, coloring and texturing additives or specialty finishes and apply to concrete for a specific purpose.

**Outcome: 5.8. Water Distribution Systems**

Calculate the demand for specific water applications and design and install water supply and drainage components.

**Competencies**

5.8.1. Calculate water demand for specific applications.

5.8.2. Compare the types, applications and operating principles of pumps and controls.

5.8.3. Locate water system entry points, walls and chases.

5.8.4. Identify components of supply and drainage systems and describe their functions.

5.8.6. Describe factors that are considered when planning and installing a supply and drainage system.

5.8.7. Estimate and compute length, angle of measurement, area, surface area and volume to calculate pipe legs and pipe sizes.

5.8.8. Calculate the slope required for drainage components.

5.8.9. Select supply and drainage components based on their application for a given purpose.

5.8.10. Explain the impact of modifying structural members to accommodate supply and drainage lines.

5.8.11. Join pipe, pipefittings and valves of similar and dissimilar materials using solder, brazing, solvents and mechanical means of joining.

5.8.12. Connect plumbing fixtures and appliances to a supply and drainage system.

5.8.13. Compare and contrast sources of contamination in water supplies and methods of filtering and disinfecting water.

5.8.14. Prevent freezing and mechanical damage to pipes.

5.8.15. Describe how water moves from the source through the water distribution system to the fixture.

5.8.16. Test a water supply and drainage system for leaks and pressure using soap, inert gas, electronic sensors and fluorescent dye.

5.8.17. Maintain plumbing fixtures.

**Strand 6.**  **Environmental Science**

Learners apply earth, life and physical sciences to the production, extraction, processing, protection, use and renewal of both renewable and non-renewable resources.

**Outcome: 6.1. Soils**

Apply knowledge of soil characteristics and soil information resources to overcome any existing soil use limitations while maintaining or improving soil quality.

**Competencies**

6.1.1. Identify soil forming factors and explain how they produce variability in soils.

6.1.2. Describe the relationship among physical properties of soils.

6.1.3. Collect, test and analyze soil samples for physical and chemical properties.

6.1.4. Identify and describe factors (e.g., climate, soil texture, mineralogy, soil organisms, drainage co-efficient, land use, vegetation types, management practices) affecting organic matter and its function in soil quality.

6.1.5. Determine land use and identify land capabilities classes.

6.1.6. Identify and describe soil conservation practices to reduce soil erosion and compaction.

6.1.7. Compare and contrast the causes and effects of soil erosion.

6.1.8. Describe soil limitations in agronomic, urban and natural resource practices.

6.1.9. Evaluate soil survey data and implement management decisions.

**Outcome: 6.2. Water Quality**

Analyze, interpret, and manage the biological, chemical and physical properties of water quality.

**Competencies**

6.2.1. Assess and explain the interactions between human activities and the Earth’s hydrosphere (e.g., septic systems, desalinization, point and non-point source pollution).

6.2.5. Explain the biotic and abiotic factors affecting water quality.

6.2.6. Monitor and analyze water quality and quantity.

6.2.7. Identify and describe best management and industry (e.g., agriculture, timber production, construction) production practices that maintain or improve water quality.

**Outcome: 6.10. Ecosystems**

Evaluate biotic and abiotic components and relationships in ecosystems to apply restoration and conservation practices that maintain functionality.

**Competencies**

6.10.3 Identify and classify interactions among organisms, including predation, symbiosis and competition, to determine species interdependent relationships.

6.10.5 Connect biotic interactions with the abiotic environment.

6.10.8 Select and implement restoration ecology practices to repair damaged ecosystems.

**Outcome: 6.11. Habitat Management and Restoration**

Develop a plan for the management and restoration of a specific habitat.

**Competencies**

6.11.8 Develop a management plan for the restoration and sustainability of a specific habitat using environmental practices that enhance biological diversity.

**Strand 8.**  **Plant Science**

Learners apply principles of plant anatomy, physiology, nutrition and genetics to the research and development, selection and reproduction, planting, fertilization, health, harvesting and management of plants in a domestic and/or natural environment.

**Outcome: 8.1. Plant Nutrition**

Select and apply macronutrients and micronutrients based on deficiencies identified using testing application methods and optimum management that account for environmental factors.

**Competencies**

8.1.8. Calculate nutrient requirements and select nutrient sources and additives for the highest potential yield.

8.1.9. Calculate nutrient requirements and select nutrient sources and additives for highest return on investment.

8.1.10. Determine the nutrient content of organic and inorganic fertilizers.

8.1.11. Select the methods and time of nutrient application and apply nutrients.

**Outcome: 8.3. Pest Management**

Develop and implement an integrated pest management (IPM) plan by scouting and identifying specific plant pests and the damage they cause and applying specialized control methods.

**Competencies**

8.3.1. Identify and classify insects, weeds, pathogens, animal pests, and describe the damages they cause.

8.3.2. Examine the interrelationships of the disease triangle among host, pathogen and environment.

8.3.3. Analyze and calculate the economic threshold of pest damage.

8.3.4. Determine the components of an integrated pest management plan and related safety practices.

8.3.5. Describe native and transgenic adaptations and modifications that have led to plant tolerance or resistance to fungal, bacteria and insect pests.

8.3.7. Develop an IPM plan, based on pest life cycles, available treatments, application methods and evaluate its impact on the environment (e.g. drift, application rate and long-term soil health).

**Outcome: 8.4. Growth and Management**

Manage and manipulate plant development through the selection, planting and growing of seeds and plants, based on global demand, economic importance and growing conditions.

**Competencies**

8.4.1. Identify and classify plants using taxonomy.

8.4.2. Identify plant anatomical structures and their functions.

8.4.3. Identify and classify seeds.

8.4.5. Explain the requirements of photosynthesis and identify the products and byproducts.

8.4.6. Explain the process and importance of transpiration in plant growth and development.

8.4.7. Understand aerobic respiration and its relationship to plant growth and management.

8.4.8. Identify the principles of primary and secondary plant growth.

8.4.9. Identify plant responses to plant growth regulators and different forms of tropism.

8.4.10. Understand the environmental and artificial factors that influence plant germination, growth and development.

8.4.11. Select, evaluate and prepare soil or media for planting.

8.4.13. Evaluate and implement planting practices.

8.4.14. Describe factors related to seed quality, treatment, and density that affect emergence, stand uniformity and seedling health.

8.4.15. Evaluate and implement transplanting practices.

8.4.16. Control plant growth through mechanical and chemical means.

8.4.17. Analyze plant water requirements and describe methods of irrigation.