**Course Description:**

Students will learn the operational practices needed for the successful growth of nursery stock and/or greenhouse plants. They will learn essential greenhouse practices including water and fertilizer distribution, lighting, ventilation and temperature control. Students will learn pest and disease identification and control along with bio-security practices. Students will demonstrate knowledge of propagation methods, plant health, nutrition, and growth stimulation. Throughout this course, business and employability skills will 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.

1.2.10. 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.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe and healthy work environment.

1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice).

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission [EEOC]).

1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational and professional ethical standards.

**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).

1.4.5. 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).

**Outcome: 1.6. Business Literacy**

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

**Competencies**

1.6.1. Identify business opportunities.

1.6.5. 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.

**Outcome: 1.8. Operations Management**

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

**Competencies**

1.8.1. Forecast future resources and budgetary needs using financial documents (e.g., balance sheet, demand forecasting, financial ratios).

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.

1.8.8. Identify routine activities for maintaining business facilities and equipment.

**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).

1.9.8. Identify income sources and expenditures.

**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.

1.10.7. Describe the importance and diversity of distribution channels (i.e., direct, indirect) to sell a product.

1.10.8. Use promotional techniques to maximize sales revenues (e.g., advertising, sales promotions, publicity, public relations).

1.10.9. Describe how product mix (e.g., product line, product items) maximizes sales revenues, market, share and profit margin.

1.10.10. Demonstrate sales techniques.

**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.

1.12.14. Identify the source of electrical hazards and use shutdown and established lock-out/tag-out procedures.

1.12.15. Select and operate fire extinguishers based on the class of fire.

1.12.17. Identify symptoms of exposure to health-threatening environments (e.g., temperature; chemical noise, vibration, harshness [NVH] hazards)..

*An “X” indicates that the pathway applies to the outcome.*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | X | Horticulture |
|  | Natural Resource Management |  | Power Technology | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | |  | Does not apply | | |

**Strand 3. Biotechnology**

Learners apply the skills and knowledge of interpreting laboratory requests, using protective clothing and hazardous material containment, specimen collection procedures, a variety of laboratory testing and techniques and the maintenance of laboratory equipment and supplies.

**Outcome 3.8. Research and Experiments**

Conduct a problem-based study, applying scientific methodology and using descriptive statistics to communicate and support predictions and conclusions.

3.8.4. Establish and implement procedures for systematic collection, organization and use of data.

3.8.5. Select and apply sampling methods that appropriately represent the population to be studied.

**Strand 5. Structural Engineering**

Learners apply the principles of engineering related to electricity, structural repair and design, use of brick, block and concrete, water distribution, and metal working to design, construct, manage and maintain structures and biological systems used in agriculture, food and natural resources.

**Outcome: 5.1. Electrical Theory**

Interpret and apply electrical and electronic principles and theories.

**Competencies**

5.1.1. Interpret symbols and wiring diagrams.

5.1.6. Describe the differences between alternating current (AC) and direct current (DC).

5.1.7. Compare and contrast conductors and insulators.

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

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

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

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

**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 (e.g., Halogen, light-emitting diode [LED], incandescent, fluorescent, high-intensity discharge [HID]).

5.2.9. Install and service low-voltage lighting and control systems.

5.2.10. Install lighting fixtures, wiring devices and covers.

*An “X” indicates that the pathway applies to the outcome~~.~~*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | | X | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**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 factors (e.g., climate, vegetation, soil texture, drainage, management practices, landscape) affecting organic matter and its function in soil quality.

**Outcome: 6.2. Water Quality**

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

**Competencies**

6.2.4. Explain the hydrological cycle (e.g., condensation, evaporation, transpiration) and how human and animal activity impacts the cycle.

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. Implement procedures and management practices that maintain or improve water quality.

**Outcome: 6.7. Solid Waste and Renewable Resource Management**

Control and process solid waste using current and alternative technologies.

**Competencies**

6.7.1. Collect, analyze and treat solid waste materials (e.g., mortalities, manure, garbage).

6.7.2. Distinguish the risks associated with solid waste accumulation, utilization and disposal.

6.7.3. Determine an acceptable site for solid waste disposal.

6.7.4. Compare the processes of aerobic and anaerobic waste decomposition.

6.7.5. Describe and monitor solid waste disposal procedures (e.g., landfill, compost).

6.7.6. Describe and implement solid waste management methods (e.g., composting, incineration, recycling, burial).

6.7.7. Explain the control processes and potential uses for solid waste byproducts (e.g., leachate, ash, landfill gas, sludge, methane, manure).

6.7.8. Describe standard operating procedures and identify design requirements for specific purposes (e.g., landfill, lagoon, leachate treatment).

6.7.9. Evaluate site closure methods and post-closure monitoring.

6.7.10. Determine type and volume of solid waste generated by an operation or facility.

*An “X” indicates that the pathway applies to the outcome~~.~~*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | | X | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**Strand 7. Food Science**

Learners apply principles of biology, chemistry and physics to the research, development, production, processing and distribution of food products meeting quality assurance standards in a system that is safe and secure.

**Outcome: 7.7. Biosecurity**

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

**Competencies**

7.7.1. Investigate sources and origins of agents that can contaminate processed and unprocessed food products.

7.7.2. Identify activities and biological agents that contribute to the risk of acquiring or preventing a specific disease.

7.7.3. Identify sources of biological and chemical tampering points.

7.7.4. Assess a facility's biosecurity, classify the level of risk and recommend improvements.

7.7.6. Screen and test animals and plant products for infectious agents or contamination.

7.7.7. Select bio-containment practices (e.g., quarantine, eradicate, showering into facilities) to manage pests and diseases.

*An “X” indicates that the pathway applies to the outcome~~.~~*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | | X | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**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**

8.1.1. Compare and contrast organic and inorganic sources of macronutrients and micronutrients.

8.1.2. Describe the functions of macronutrients and micronutrients in plants and the role that microorganisms play in plant nutrition.

8.1.3. Determine the nutrient requirements of plants.

8.1.4. Identify symptoms and causes of plant nutrient deficiencies and toxicities.

8.1.5. Collect soil and plant tissue for testing and analysis.

8.1.6. Analyze and draw conclusions from soil and plant tissue test data.

8.1.7. Distinguish between biotic and abiotic factors (e.g., minerals, pH, microorganisms) that influence and optimize the availability of nutrients for plants.

8.1.8. Calculate nutrient requirements and select nutrient sources and additives for optimum economic return.

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

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

**Outcome: 8.2. Plant Reproduction**

Propagate and cultivate plants for specific characteristics and economic variables for both greenhouses and crops.

**Competencies**

8.2.1. Identify the reproductive anatomy of plants and describe their physiological functions.

8.2.2. Describe how biotic and abiotic factors (e.g., insects, light, temperature, microorganisms, moisture, location) influence and optimize plant reproduction.

8.2.3. Compare and contrast variations of plant reproductive systems among plant species.

8.2.4. Select seeds and seed stock for desired traits.

8.2.5. Select and apply methods that create desired traits in seeds.

8.2.6. Select and apply all methods of asexual plant propagation for desired traits (e.g., grafting, layering, cutting, cloning).

**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 apply specialized control methods.

**Competencies**

8.3.1. Identify and classify insect, weed, disease and animal pests.

8.3.2. Examine the interrelationships among plants, pests, humans and the environment.

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

8.3.4. Determine and implement pest management safety practices (e.g., safety data sheets [SDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA], personal protective equipment [PPE], worker protection standards [WPS], refuge management strategy).

8.3.5. Evaluate the effectiveness of a pest management plan.

8.3.7. Describe the types and functions of biological and mechanical control methods.

8.3.8. Describe the types and functions of chemical pesticide control measures.

8.3.9. Develop an IPM plan, based on pest life cycles, available treatments, application methods and the impact on the environment.

8.3.10. Select application methods and implement an IPM plan.

8.3.11. Evaluate IPM plans and applications for their impact on the environment and their effectiveness.

**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 tissues.

8.4.3. Identify and classify seeds and plants at all stages of growth.

8.4.4. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.

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

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

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

8.4.8. Understand the influence of environmental factors on plant growth, development and maintenance.

8.4.9. Manipulate natural and artificial factors to influence plant germination, growth and development.

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

8.4.11. Understand and evaluate the process by which plants are selected.

8.4.12. Evaluate and implement planting practices (e.g., population rate, germination, seed vigor, inoculation, seed and plant treatments, type of planter, cuttings, pot in pot).

8.4.13. Evaluate and implement transplanting practices.

8.4.14. Control plant growth through mechanical and chemical means.

8.4.15. Analyze plant water requirements and provide water through artificial or natural means.

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

8.4.17. Recognize plant disease symptoms, prevention, avoidance and treatments.

**Outcome: 8.5. Harvesting**

Evaluate and implement harvesting methods to maximize yield.

**Competencies**

8.5.1. Identify characteristics of grains, seeds, vegetables, fruits and ornamental plants that indicate crop maturity.

8.5.2. Describe safety precautions to take when harvesting.

8.5.3. Adjust to environmental conditions to enhance the harvesting of plant products.

8.5.4. Evaluate techniques to maximize yield through mechanical or hand harvesting methods.

8.5.5. Calculate potential yield and loss due to harvesting.

8.5.6. Evaluate the impact of harvest techniques on the quality of plants and plant products.

8.5.7. Identify harvesting methods and harvesting equipment.

8.5.8. Assess the stage of growth to determine the maturity and salability of grains, seeds, vegetables, fruits and ornamental plants.

8.5.10. Implement non-mechanized harvesting techniques.

8.5.11. Evaluate crop yield and loss data.

8.5.12. Implement management practices to reduce loss.

**Outcome: 8.6. Handling and Storage**

Handle and store plants and plant products to maximize quality.

**Competencies**

8.6.1. Describe safety precautions in handling and storage practices.

8.6.2. Adjust to environmental conditions to enhance the handling and storage of plant products.

8.6.3. Apply harvesting, handling and storage techniques to minimize loss and maximize economic return.

8.6.4. Calculate potential yield and loss due to processing and storage.

8.6.5. Explain the proper conditions to maintain the quality of plants and plant products held in storage.

8.6.6. Maintain and enhance the quality of plant products through the manipulation of handling and storage techniques (e.g., temperature, humidity, retardants, light, chemicals, contamination).

8.6.7. Prepare products for sale, transportation and storage.

8.6.8. Identify storage methods for plants and plant products.

8.6.9. Monitor environmental conditions in storage facilities for plants and plant products.

8.6.10. Explain the reasons for preparing plants and plant products for distribution.

8.6.11. Implement and evaluate techniques for grading, handling, packaging and loading plants and plant products for distribution or transportation.

*An “X” indicates that the pathway applies to the outcome~~.~~*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | | X | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |