# Agricultural and Environmental Systems Career Field

## Foundations of Sustainable and Innovative Agriculture and Natural Resources

**Subject Code: TBD**

**Outcome & Competency Descriptions**

**Course Description:**

This course will focus on the purpose, resources, indoor and outdoor growing operations, production strategies, business development, and financing as it applies to innovative agricultural production in urban, suburban, and rural communities: This course will focus on the purpose, resources, indoor and outdoor growing operations, production strategies, business development, and financing as it applies to innovative agricultural production in urban, suburban, and rural communities.

**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.

1.1.6. 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.

**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.

1.2.5. 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.

**Outcome: 1.3. Business Ethics & 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.

**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.

**Outcome: 1.6. Business Literacy**

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

**Competencies**

1.6.1. Identify business opportunities.

1.6.4. Identify types of businesses, ownership and entities (i.e., individual proprietorships, partnerships, corporations, cooperatives, public, private, profit, not-for-profit).

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

**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).

1.9.2. Identify tax obligations.

1.9.8. Identify income sources and expenditures.

**Outcome: 1.11. Principles of Business Economics**

Examine and employ economic principles, concepts and policies to accomplish organizational goals and objectives.

**Competencies**

1.11.8. Identify the relationships between economy, society and environment that lead to sustainability.

**Strand 2. Animal Science**

Learners apply principles of animal anatomy, physiology, genetics, behavior, nutrition and production to the research and development, selection and reproduction, health and management of animals in domestic and natural environments.

**Outcome: 2.1. Nutrition**

Analyze, formulate, prepare and administer a ration for a population of specific animal species based on the economics, nutrition and availability of feedstuffs and evaluate the feed's effects on animals, and animal products.

**Competencies**

2.1.1. Identify the traditional and alternative types, compositions, quality and compatibility of feedstuff, feed additives and feed byproducts.

2.1.2. Describe the role of nutrients and nutritional requirements of different animal life processes and species.

**Outcome: 2.3. Care and Management**

Apply animal care, management and record procedures to ensure husbandry and welfare, including managing environmental conditions to ensure health and performance.

**Competencies**

2.3.2. Identify, classify, evaluate and select animal species or breeds for a desired outcome.

2.3.3. Determine the biotic and abiotic factors (e.g. air, ventilation) that impact the animal's environment.

2.3.4. Apply concepts of pest control and nuisance animal control, sanitation, and disinfection procedures for animals' care and management.

2.3.6. Calculate a facility or habitat's carrying capacity and its impact on animal health.

2.3.8. Evaluate and perform animal care procedures aligned with industry standards throughout the life of the animal.

2.3.9. Monitor and evaluate the quality of an animal's habitat and implement corrective methods as needed.

**Strand 3. Biotechnology**

Learners engage in the scientific process, learn fundamental processes using modern tools and laboratory techniques, adhere to safety protocols, and bring a biotechnology product to the market.

**Outcome: 3.1. Research and Experiments**

Use scientific methodology to conduct problem-based studies, develop products, and interpret results.

**Competencies**

3.1.14. Describe how biotechnology products are produced and used in the United States.

3.1.15. Describe how biotechnology products are regulated in the United States.

**Outcome: 3.2. Laboratory Standard Operational Procedures**

Conduct experiments using proper industry-based protocols, methods and techniques.

**Competencies**

3.2.2. Prepare and dispense stock reagents, buffers, media, and solutions by calculating concentrations, adjusting factors such as pH, and selecting purification techniques and equipment.

**Outcome: 3.3. Specimen, equipment, and chemical handling**

Handle, prepare, transport, store and dispose of specimens and chemicals. Monitor, record and maintain the integrity of equipment and instrumentation, environmental conditions of the facility and inventory.

**Competencies**

3.3.1. Prepare and interpret labels for chemicals, supplies, and equipment.

3.3.2. Use chemical references to identify hazards associated with handling and storing chemicals.

3.3.3. Safely transfer chemicals from storage containers to equipment used in the laboratory.

3.3.7. Select personal protective equipment for various laboratory protocols.

**Outcome: 3.6. Molecular-Genetics Technology**

Apply knowledge of genetic inheritance and modification to organisms and use genetic information and bioinformatics to analyze specimens.

**Competencies**

3.6.21. Explain gene by environment interactions.

**Strand 5. Elements of Production**

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

**Outcome: 5.5. Geographic Information Systems (GIS)**

Employ GIS computer applications to interpret data, maps and land use.

**Competencies**

5.5.12. Identify suitability of given area for agricultural applications

**Outcome: 5.12. Precision Agriculture**

Analyze data from precision agriculture platforms and prepare recommendations.

**Competencies**

5.12.2. Identify and explain precision agriculture platforms and differentiate uses and benefits for specific platforms.

5.12.3. List specific precision agriculture techniques for pesticide application, yield mapping, soil analysis, tillage and planting operations, animal feed and water systems, temperature-controlled housing and specific machine functions.

5.12.8. Apply precision agriculture information to specifically reduce the negative environmental impacts of production practices.

**Outcome: 5.15. Animal Behavior**

Apply management practices to assure animal welfare considering species-specific behaviors, human safety, social influences, public perception and regulations associated with animal welfare.

**Competencies**

5.15.1. Understand social influences, public perception and regulations that are associated with animal welfare.

5.15.7. Humanely handle, restrain and move animals.

**Outcome: 5.16. Biosecurity**

Connect the sources and causes of contamination and develop protocols to implement biosecurity procedures.

**Competencies**

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

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

5.16.5. Implement biosecurity procedures to prevent cross-site contamination (e.g., proper use and disposal of personal protective equipment [PPE] from site to site, vehicle cleaning between farm and processing site).

**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.

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

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

**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).

6.2.3. Measure vegetation, temperature, turbidity, macroinvertebrate populations, and bacterial quality in lentic and lotic waters to determine water quality.

**Outcome: 6.3. Air Quality**

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

**Competencies**

6.3.2. Explain biogeochemical cycles (e.g., nitrogen, oxygen, sulfur) and how they relate to the biosphere, geosphere and atmosphere.

6.3.5. Explain human and natural factors (e.g., transportation, farming practices, greenhouse gases, forest fires, volcanic eruptions) affecting air quality.

**Outcome: 6.4. Water use and management**

Collect, analyze and interpret data for a localized water use and management plan.

**Competencies**

6.4.9. Identify and describe best management practices that conserve and sustain water.

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

Control and process solid waste using current and alternative technologies.

**Competencies**

6.7.6. Describe and monitor solid waste disposal procedures and management procedures (e.g., composting, incineration, recycling, burial, bio digester).

**Outcome: 6.8. Contaminants and Pollution Control**

Assess an affected area, determine the source and type of contaminant and respond.

**Competencies**

6.8.1. Collect, record and analyze environmental samples and interpret the results.

**Outcome: 6.10. Ecosystems**

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

**Competencies**

6.10.1. Describe ecological levels, including population, community, ecosystem, biome and biosphere.

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

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

**Competencies**

6.11.3. Evaluate the current and historical (e.g., industrialism, agriculture, climate change) impacts of human interactions on ecosystems and habitats.

6.11.7. Implement techniques used in habitat management, mitigation, enhancement and restoration.

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**

8.1.3. Identify and describe the nutrient recommendations of a plant for a desired production setting.

8.1.6. Analyze and draw conclusions from soil and plant tissue test data and determine management recommendations for increase production, increase profitability, enhance environmental protection and improved suitability.

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

8.1.12. Describe and apply the 5 R's of nutrient management: (1) right source of fertilizer at the (2) right rate at the (3) right time in the (4) right place with the (5) right irrigation method.

**Outcome: 8.2. Plant Reproduction**

Propagate plants and cultivars for specific performance characteristics under a variety of production systems.

**Competencies**

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

8.2.4. Describe how artificial selection methods are used in plant breeding to improve plant traits.

8.2.5. Select and apply methods of asexual plant propagation.

**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 damage they cause.

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

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**

Explain, manage and manipulate plants through all stages of growth and development.

**Competencies**

8.4.1. Identify and classify plants using taxonomy.

8.4.2. Identify plant anatomical structures and their functions.

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

8.4.15. Evaluate and implement transplanting practices.

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

8.4.18. Compare and contrast inorganic and organic production practices.

8.4.20. Compare and contrast management practices in controlled and natural growing environments.

**Outcome: 8.5. Harvesting**

Describe and implement harvesting methods.

**Competencies**

8.5.1. Determine crop readiness for salability and environmental conditions that can impact crop quality at harvest.

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

**Strand 9. Energy**

Learners apply principles of physics, chemistry, earth sciences and mathematics to energy sources, transformations, acquisitions, applications and their impacts.

**Outcome: 9.1. Energy Sources**

Identify energy sources according to their economic viability, sustainability and environmental impact.

**Competencies**

9.1.3. Identify, compare and contrast alternative and emerging energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).

9.1.4. Identify the social, economic and environmental drivers and barriers that influence the development and use of energy sources.

**Outcome: 9.3. Biomass**

Describe and manage processes required to extract energy from biomass.

**Competencies**

9.3.1. Identify applications for biomass energy production.

9.3.2. Describe the thermal, chemical and biochemical methods of converting biomass into energy.

**Outcome: 9.4. Solar Energy**

Plan, install and maintain a solar array that can collect, store and distribute solar energy.

**Competencies**

9.4.1. Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP]) and how they produce energy.

**Outcome: 9.5. Wind Energy**

Plan and maintain a wind energy installation that captures, stores and distributes electrical energy.

**Competencies**

9.5.4. Identify, describe, and differentiate wind technologies used for wind energy production.