# Agricultural and Environmental Systems Career Field

## Agronomic Systems

**Subject Code: 010620**

**Outcome & Competency Descriptions**

**Course Description:**

Students will apply knowledge and skills required to research, develop, produce and market major agricultural and horticultural crops. Cultural and sustainable production practices will be examined while students apply scientific knowledge of plant development, nutrition and growth regulation. The knowledge and skills needed to manage water, soils, and pests related to agronomic crops will be assessed. Students will employ technological advances, communication, business, and management strategies appropriate for the industry.

**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.

**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.

1.2.6. 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.

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

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

**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.

1.3.4. 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.

1.3.8. Verify compliance with computer and intellectual property laws and regulations.

**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**

1.4.2. 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.

1.4.5. 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.

**Outcome: 1.6. Business Literacy**

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

**Competencies**

1.6.3. Explain the importance of planning your business.

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**

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

1.8.3. Analyze the performance of organizational activities and reallocate resources to achieve established goals.

1.8.9. Develop a budget that reflects the strategies and goals of the organization.

1.8.10. Analyze how business management and environmental management systems (e.g., health, safety) contribute to continuous improvement and sustainability.

**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.

1.9.3. Review and summarize savings, investment strategies and purchasing options (e.g., cash, lease, finance, stocks, bonds).

**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.

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

1.12.6. 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.

**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**

3.1.3. Apply sampling methods that appropriately represent the population, and implement procedures for systematic data collection.

3.1.4. Explain the importance and design of trialing and the information gained from it.

**Strand 4. Power Systems**

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

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

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

**Competencies**

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

4.1.2. Identify the 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.

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

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

**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 resource systems.

**Outcome: 5.4. Surveying and Mapping**

Perform surveying procedures to construct a site plan.

**Competencies**

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: 5.5. Geographic Information Systems (GIS)**

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

**Competencies**

5.5.1. Interpret and evaluate the accuracy of digital imagery and aerial photography.

5.5.2. Explain map projections and the use of scales.

5.5.11. Assess soil compaction and analyze the correlation between soil compaction data and pixel value.

5.5.14. Interpret results to create crop reports, prescriptions, and application maps.

5.5.16. Use geospatial technology to develop soil sampling grids or identify sampling sites for testing characteristics such as nitrogen, phosphorus, or potassium content, pH, or micronutrients.

**Outcome 5.12. Precision Agriculture**

Analyze data from precision agriculture platforms and prepare recommendations.

**Competencies**

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.

5.12.12. Explain and figure variable rate for production goal.

**Outcome: 5.16. Biosecurity**

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

**Competencies**

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).

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

**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.

6.1.10. Assess basic processes (e.g., slope stability, water control, earth material control, vegetative treatment, soil amendments) of soil reclamation.

**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).

6.2.2. Measure pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrogen, and phosphorus in lentic and lotic waters to determine water quality.

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

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

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

6.7.3. Determine an acceptable site for solid waste disposal.

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

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

**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.

6.8.2. Determine the types, sources, and impact of natural, human-made contaminants, and high-risk contaminants.

6.8.3. Monitor, analyze, and quantify levels of contaminants from point and non-point sources.

6.8.6. Identify, comply with, and implement best management practices for contaminant control, remediation, and prevention (e.g., biological, sanitation, buffer strips).

6.8.10. Identify and describe requirements to develop and implement various emergency response plans.

6.8.12. Analyze environmental conditions that influence environmental response.

**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.

6.11.5. Survey and monitor species within a habitat.

6.11.6. Explain the role of various stakeholders, including individuals, non-governmental organizations (NGOs), corporations and governments in habitat restoration and conservation.

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.

6.11.9. Implement habitat restoration and sustainability management plan environmental practices.

**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 from the use of industry-driven 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. Identify and describe the nutrient recommendations of a plant for a desired production setting.

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 using standard industry practice.

8.1.6. Analyze and draw conclusions from soil and plant tissue test data and determine management recommendations to 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.

8.1.8. 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.

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**

8.2.1. 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 plant reproduction.

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

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 apply specialized control methods.

**Competencies**

8.3.1. Identify and classify insects, weeds, pathogen, and 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, bacterial and insect pests.

8.3.6. Describe the types and functions of biological, mechanical and chemical control methods.

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.

8.4.3. Identify and classify seeds.

8.4.4. Identify and classify plants and describe management decisions at all stages.

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. Explain 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.

8.4.12. Understand and evaluate the process by which plants are selected in relation to production use.

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.

8.4.16. Control plant growth through mechanical and chemical means.

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

8.4.18. Compare and contrast inorganic and organic production practices.

8.4.19. Identify and describe production practices that lead to plant resistance and tolerance.

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

8.4.21. Distinguish between biotic and abiotic factors that influence plant stress.

**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.

8.5.2. Describe safety precautions to take when harvesting.

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

8.5.4. Calculate potential yield and loss due to harvesting.

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

8.5.6. Identify and implement harvesting methods and equipment.

8.5.7. Implement management practices to reduce loss.

**Outcome: 8.6. Handling and Storage**

Handle and store plants and plant products to maximize quality and longevity.

**Competencies**

8.6.1. Describe safety precautions in handling and storage practices.

8.6.2. Explain, monitor, and manipulate conditions for optimal handling and storage of plant products.

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

8.6.4. Prepare products for sale, transportation, and storage.

8.6.5. Identify storage methods and storage capacity for plants and plant products.

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

8.6.7. Implement and evaluate techniques for grading, handling, blending, segregating, packaging, and loading of plants and plant products for distribution or transportation.