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ABSTRACT

This document describes the essential competencies from secondary through post-secondary associate degree programs for a career in agricultural business and production systems. Following an introduction, the Ohio College Tech Prep standards and program, and relevant definitions are described. Next are the technical competency profiles for these areas: animal science, plant science, business operations, engineering, and environmental science. Each contains a standard statement; benchmarks for foundation programs, secondary workplace development programs, and postsecondary programs; the subject topics with indicators (competencies). Appendixes A and B list the members of the review panels. Appendix C contains a blank template that can be used to prepare a college preparation pathway with spaces to list classes and prerequisites. Appendix D is a list of careers with job descriptions in agricultural and environmental systems. Appendix E contains a map showing the Ohio Tech Prep Consortia. (SLR)

Ohio Agricultural Business and Production Systems

Technical Competency Profile (TCP)

2003

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Course Code 010301

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Acknowledgements

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Introduction

The Agricultural and Environmental Systems Content Standards and related Technical Competency Profile (TCP) are collaboratively developed by the Ohio Department of Education, Ohio Board of Regents, and Office of Career-Technical and Adult Education. The standards provide a framework for a broad-based secondary/post-secondary curriculum.

This document is designed to support innovate program design and career planning. The content standards outline the essential knowledge and skills that are to be delivered in secondary and postsecondary career and technical programs. Each of the six content standards contains essential benchmarks and indicators that students are expected to know and are able to do. The list of benchmarks and indicators are also linked to the careers and industry sectors that comprise agricultural and environmental systems.

Representatives from a broad spectrum of business and education professionals played a critical role in defining the vision and scope of the content standards. A list of business/industry representatives and educators participating in the development of the profile appear in Appendices A and B.

Technical Competency Profiles (TCP) are used as the basis for the development of an integrated delivery system that provides opportunities for new and challenging programs and courses. Career-Technical Education, College Tech Prep, and post-secondary degree programs will be enhanced and expanded through the use of the Technical Competency Profile (TCP).

The Agricultural and Environmental System Content Standards and related TCPs are available on the Internet at http://cms.osu.edu/standardshome.html or at www.ohtpcs.org. At these locations users can download copies of the entire profile or conduct searches on a number of key variables.

College Tech Prep Program Standards

College Tech Prep programs are rigorous programs of study starting at the secondary school level and continuing through the associate degree and beyond. In accordance with the Carl D. Perkins Vocational Technical Education Enhancement Act of 1998, College Tech Prep programs are seamless, non-duplicative programs of study combining high-level academic and technical preparation in a variety of career fields.

The Carl D. Perkins Vocational and Technical Education Act of 1998 defines College Tech Prep as:

> *A program that provides technical preparation in a career field such as engineering, applied science, a mechanical, industrial or practical arts or trade, agriculture, health occupations, business or applied economics and must do the following:*
> - *Combines at least two years of secondary and two years of post-secondary education in a sequential course of study without duplication of coursework*
> - *Integrates academic, vocational and technical education, and if appropriate and available, work-based learning*
> - *Provides technical preparation for careers*
> - *Leads to an associate or a baccalaureate degree or post-secondary certificate in a specific career field*
> - *Leads to placement in appropriate employment or further education.*

The Ohio College Tech Prep Advisory Council recommended to the Ohio Board of Regents and the Ohio Department of Education the following standards for all College Tech Prep programs:

1. Academics are taught at a college-preparatory level and are aligned with state models and academic content standards.
2. In addition to Ohio graduation requirements specified in SB 55, required academic components for College Tech Prep programs include:
    a. Mathematics taught at a minimum level of Algebra II by the completion of high school.
    b. An integrated or stand alone senior-year math component
    c. Three units of science including at least two lab-based science courses
3. College Tech Prep programs will use a state-developed Technical Competency Profile (TCP) as the basis for pathway development. The pathway document should reflect secondary and post-secondary course work and should be made available for stakeholders. All secondary and post-secondary TCP competencies must be clearly identified and addressed. The TCP is the framework used to develop all associated curricular documents; however, components from other competency profiles such as OCAP's (Occupational Competency Analysis Profile), ITAC's (Integrated Technical and Academic Competencies) and SCANS (The Secretary's Commission on Achieving Necessary Skills—America 2000) may be included and are not mutually excluded from a TCP.
4. Articulated pathways will be reviewed every two-years at the consortia level.
5. Pathways operate under an articulation agreement between/among partners in a consortium.
6. College Tech Prep programs at the secondary level will operate as state-approved, career-technical education programs.
7. Academic and technical instruction is integrated and delivered in a contextual approach where possible.
8. Programs have common representation from secondary education, higher education, business, and labor members.
9. Post-secondary programs contain advanced skills in the TCP document.
10. Programs must operate under either regionally accredited post-secondary institutions/degrees or approved apprenticeship programs meeting U.S. Department of Labor standards.
11. College Tech Prep programs, secondary and post-secondary, must comply with the state College Tech Prep Advisory Council's performance measures.

State College Tech Prep Advisory Council
Revised and Approved: May 1, 2002

College Tech Prep

College Tech Prep is a high school and college career path linked to business, industry, and labor that insures a specified seamless pathway from high school to college to careers, meeting Ohio's technological employment needs.

A College Tech Prep student is enrolled in a state-approved College Tech Prep education program. A College Tech Prep Program means a program of study that:

- Combines, at a minimum, two years of secondary education (as determined by Ohio definitions) with a minimum of two years of post-secondary education in a non-duplicative, sequential course of study.

- Integrates academic and technical instruction and utilizes work-based and work-site learning, where appropriate and available.

- Provides technical preparation in a career field such as engineering technology; applied science; mechanical; industrial or practical arts or trades; agriculture; health occupations; business; or applied economics.

- Builds student competencies in mathematics, science, reading, writing, communications, economics, and workplace skills through applied, contextual academics, and integrated instruction, in a coherent sequence of courses.

- Leads to an associate or baccalaureate degree, or a BAT (Bureau of Apprenticeship Training) apprenticeship requiring a minimum of two years in a specific career field.

- Leads to placement in related employment, or to further education.

Content Standards Development

The development of the Agricultural and Environmental Systems Content Standards and related Tech Prep Competency Profiles were accomplished in two phases. The first phase involved work in both labor market and content development. The labor market analysis identified those careers that comprise agricultural and environmental systems industry sectors. Next it was necessary to develop the body of knowledge that students should know and be able to do in order to succeed in their career of choice. This body of knowledge is reflected in a set of standards, benchmarks, and indicators for agricultural education programs. Agricultural education faculty and business representatives contributed to the development of the listing of related careers and the content standards.

The second phase involved the verification of careers and content standards that will be used for college tech prep program development. Again, business persons and agricultural education faculty identified the knowledge and skills required for those careers where a technical degree or greater is recommended.

Phase One

The Advisory Panel

An advisory panel was assembled from the three major groups of people who are expected to use the content standards: secondary educators, postsecondary educators, and teacher educators. The purpose of this panel was to help ensure that the final document was one of value to those involved in program development and delivery. The group confirmed that (1) the standards based model from which the content standards were developed was acceptable, (2) the development process as outlined was adequate, (3) the career lists and sectors were representative of industry, and (4) the final product in its electronic form was useable to educators. The panel consisted of the following individuals:

- Glenn Abke, Agriculture Business, Toledo Campus--Agriculture, Owens Community College, Toledo
- Monte Anderson, Agricultural Education Teacher Educator, Wilmington College, Wilmington
- Cyndi Brill, Agriscience/Production Agriculture Program Instructor, Canal Winchester High School, Canal Winchester
- Larry Coon, Assistant Dean of Natural Resources, Hocking College, Nelsonville
- Jamie Cano, Agricultural Education Teacher Educator, Department of Human & Community Resource Development, The Ohio State University, Columbus
- Claire Ehrlinger, Horticulture Program Instructor, Cincinnati State Technical College, Cincinnati
- Dennis Finley, Food Processing Program Instructor, R.G. Drage Career Center, Massillon

- Wesley Greene, Associate Professor, Dairy Science, The Ohio State University Agriculture Technical Institute, Wooster
- Tom Hackenbracht, Natural Resources Program Instructor, Buckeye Career Center, New Philadelphia
- Kim Jones, Animal Care Program Instructor, Medina County Career Center, Medina
- Keith Motter, Agribusiness Program Instructor, Fort Loramie High School, Fort Loramie
- Joanne Scudder, Horticulture Program Instructor, Washington Park High School, Cleveland
- William Stanforth, Animal Care Program Instructor, Live Oaks Career Development Center, Milford
- Craig Wellert, Agriculture and Industrial Mechanics Program Instructor, Wayne County Schools Career Center, Smithville
- Nick Wilson, Assistant Director, K-16 Initiatives, Ohio Board of Regents, Columbus

Research Standards, Benchmarks, and Indicators

Research was conducted so that the list of standards, benchmarks, and indicators could be compiled. Expertise was sought from a variety of teacher subject matter specialists. Six content standards were found to be appropriate for agricultural and environmental systems programs. Benchmarks and indicators were then developed according to the specific content standard. Criteria for the development of the standards, benchmarks, and indicators were drawn from the academic standards model used by the Ohio Department of Education. All competencies listed in current Integrated Technical and Academic Competency Profiles (ITAC) and Tech Prep Competencies Profiles (TCPs) were incorporated into the set of content standards.

Content standards are general statements that broadly define what students should know and be able to do. The six content areas that define the body of knowledge in agricultural and environmental systems programs include:

1. **Animal Science**
2. **Business Operations**
3. **Engineering**
4. **Food Science**
5. **Environmental Science**
6. **Plant Science**

Curriculum Organization – Benchmarks and Key Indicators

Benchmarks are more specific statements of what a student should know and be able to do as a result of their program of study. Two types of benchmarks are used, secondary benchmarks and postsecondary benchmarks. Assessments are usually written to measure student attainment of benchmarks. Examples of benchmarks from animal sciences include:

- **Secondary Benchmark (11^{th} -12^{th})**
  Feed animals using a feeding plan that meets the animal's needs
- **Benchmark Postsecondary Statement**
  Develop a feeding program for a herd of specific animal species that meets industry standards

Indicators are more specific statements of knowledge and/or skills that students will learn. Indicators serve as checkpoints to monitor progress toward learning benchmarks. Although benchmarks are written for each level of an agricultural and environmental systems program, indicators are not. A single set of indicators apply to all three levels of benchmarks. Faculty delivering instruction at each program level will apply the indicator at the breadth and depth appropriate for that level of study.

Indicators for Animal Nutrition Benchmarks

1.1 Identify types and quality of feeds
1.2 Determine the nutritional requirements for different growth stages of the animal (e.g., maintenance, growth, reproduction, lactation)
1.3 Analyze nutritional content and quality of feeds
1.4 Determine feed efficiency based on cost and availability of feeds
1.5 Formulate and prepare rations and diets
1.6 Evaluate/monitor performance of feeding systems and programs

Listing of Educational Programs and Careers

Information from a variety of governmental and non-governmental sources was used to create a database of careers associated with agricultural and environmental systems industry sectors. Governmental sources included the Ohio Department of Agriculture, Ohio Department of Natural Resources, Ohio Bureau of Employment Services, U.S. Department of Labor, and the U.S. Department of Education. Non-governmental sources used in identifying current and future careers included business and industry trade groups, professional associations, universities, and College Tech Prep consortia.

Upon completion of the careers database, the careers were organized into defined Industry Sectors that are recognized in agricultural and environmental systems. Within each Industry Sector, an informational hierarchy was created using the National Center for Statistics' Classification of Instructional Programs (CIP) Codes. The hierarchy included Career Fields, Educational Programs, and Careers. The Career Fields are used as organizers and are taken from the CIP four digit code statements. They are used to group related educational programs where individuals will study and prepare for a career. Career fields are also used to organize careers typically considered to be related to agricultural and environmental systems Industry Sectors. A career is considered to be comprised of a series of jobs that are pursued in order to achieve the ultimate occupation desired by the individual. The Advisory Committee approved this method of illustrating careers in agricultural and environmental systems. The careers list was shared with industry representatives for their input and approval (see Appendix D).

Industry Sectors

- Agronomy
- Animal Health
- Companion Animals
- Environmental
- Fish and Wildlife
- Food Processing
- Forestry
- Greenhouse/Floriculture
- Nursery/Landscape/Turf
- Power
- Production Animals
- Soil and Water
- Structural

Business Review Panels

Panels of business representatives were assembled for each of the Industry Sectors that comprise Agricultural and Environmental Systems in Ohio. Business representatives were identified through the effort of the planning team. Business panels were convened to conduct two major tasks; (1) review, modify and approve careers, educational programs, career fields, and industry sectors and to (2) review, modify and approve the content standards, benchmarks, and indicators.

Secondary and Postsecondary Agricultural Educator Review

Combined teams of faculty from both secondary and postsecondary agricultural education programs came together to review the Agricultural and Environmental Systems Content Standards. The purpose of the educator review was similar to the business panel review: (1) review, modify and approve careers, educational programs, career fields, and industry sectors and to (2) review, modify and approve the content standards, benchmarks, and indicators.

Combined Panel Review

A final panel of business representatives, secondary and postsecondary faculty, and advisory committee members convened for the purpose of approving final revisions of the content standards documents and educational program and career documents. All those who had participated in the development panels were invited to attend. Recommendations from the combined panel (Stakeholders Panel) were incorporated into the final document.

Phase Two
The College Tech Prep Review

The Panel Reviews

A review of the content standards necessary for Agricultural Business and Production Systems College Tech Prep program (TCP) and the Horticulture Tech Prep program TCP) has been completed. For this review both industry and educator panels were convened. The list of careers where a higher degree would be recommended was identified for each of the related Industry Sectors. Those careers that do not need a higher degree are identified in the career listing with an asterisk. These careers are not intended to be addressed in a College Tech Prep program. A listing of these careers can be found in Appendix D.

Both industry and educator panels examined the Agricultural and Environmental Systems Content Standards and confirmed those benchmarks and indicators that were appropriate for the careers addressed in college tech prep program Agribusiness and Production Systems TCP. A listing of panel reviewers for phase one and phase two can be found in Appendix A and Appendix B.

Definitions

Benchmark: A statement of what a student should know and be able to do in a foundation program, a specialized secondary program, or a postsecondary program. Assessment typically measures attainment of benchmarks as an indication of student progress in meeting the standard.

Career, Non-Tech Prep: A career that does not need a postsecondary degree. These career opportunities need a high school diploma, additional education leading to a certificate, and/or additional hours of informal or formal education.

Career Field: Used to organize both educational programs and careers within an individual Industry Sector. This category is used in the National CIP as a four-digit code (01.00) representing intermediate groupings of programs that have comparable content and objectives.

CIP: National Classification of Instructional Programs as developed by U.S. Department of Education's National Center for Educational Statistics. The purpose of the CIP is to provide a taxonomy scheme that supports the accurate tracking, assessment, and reporting of fields of study and program completers or program completion activities.

Content Standard: Comprehensive statements defining the broad knowledge areas required for individual preparing for careers in any of the Industry Sectors in Agricultural and Environmental Systems. There are six Content Standards in Agricultural and Environmental Systems:

- Animal Science
- Business
- Engineering
- Environmental Science
- Food Science
- Plant Science

Educational Programs: Specific instructional programs offered across the United States in secondary and/or postsecondary educational institutions. Instructional programs are listed in the CIP as 6 digit codes (01.0000).

Indicator: A specific statement of knowledge and/or skills that serve to demonstrate student progress in meeting a benchmark.

Industry Sector: A recognized group of businesses having the following attributes: common occupations for employees, common products and services, a common body of knowledge and skills used by employees, and a common professional association representing the group as a collective body.

Ohio College Tech Prep Curriculum Services

Agricultural Business and Production Systems

Animal Science

Standard Statement:

Applying principles of anatomy and physiology, nutrition, reproduction, genetics, behavior, production and management of animals raised in both a domesticate and/or natural environment. Planning, implementing, managing, and/or providing support services to the selection, breeding, feeding, health, care, and marketing of animals.

Foundation Benchmarks (in development): Students enrolled in a foundation program are expected to address all animal science principles and management practices identified in the standard. They will learn principles and management practices for recognized groups of animals found in agriculture, companion and specialty animals, equine species, fisheries, and wildlife. The focus of instruction should be on those principles and practices related to the production and management of mammals, birds and fish rather than on the specific species such as beef cattle, geese, or catfish.

Secondary Benchmarks: Students enrolled in a specialized workforce development program are expected to address the animal science principles and management practices identified in the standard. Students will apply the knowledge and skills to those animal groups that are addressed in their workforce development program. Students in Agribusiness and Production Systems would learn and apply knowledge and skills to domesticated livestock, equine, and companion animals. Students in Natural Resource Management would focus their studies on wildlife and fisheries management. Instructional activities would likely focus on the principles and practices that cross all related species in the program rather than an in-depth focus on individual species.

Post-Secondary Benchmarks: Students enrolled in a post-secondary program are expected to address the animal science principles and management practices identified in the standard. Students will apply the knowledge and skills to animal groups and specific animal species that are addressed in their major. For example, an animal science major would study principles that cross all species of livestock as well as the management practices related to specific species of livestock.

Nutrition

Secondary Benchmark:

Develop and implement an animal nutritional and feeding plan

Post-Secondary Benchmark:

Develop and evaluate a feeding and nutrition program that meets the needs for the intended use of the animal

Indicators:

1.1 Identify types and quality of feeds
1.2 Determine the nutritional requirements for different growth stages of the animal (e.g., maintenance, growth, reproduction, lactation)
1.3 Analyze nutritional content and quality of feeds
1.4 Determine feed efficiency based on cost and availability of feeds
1.5 Formulate and prepare rations and diets
1.6 Evaluate/monitor performance of feeding systems and programs
1.7 Determine the relationships between feed/agronomic production systems and feed quality

Body Systems

Secondary Benchmark:

Differentiate animal body systems

Post-Secondary Benchmark:

Explain and analyze differences among body systems of animals and describe how each system may affect the animal's performance

Indicators:

2.1 Identify external body parts
2.2 Identify the anatomy and describe the physiology of the digestive systems
2.3 Identify the anatomy and describe the physiology of the nervous system
2.4 Identify the anatomy and describe the physiology of the skeletal system
2.5 Identify the anatomy and describe the physiology of the muscular system
2.6 Identify the anatomy and describe the physiology of the circulatory system
2.7 Identify the anatomy and describe the physiology of the skin and associated structures
2.8 Identify the anatomy and describe the physiology of the respiratory system
2.9 Identify the anatomy and describe the physiology of the urinary system
2.10 Identify the anatomy and describe the physiology of the male and female reproductive systems
2.11 Identify the anatomy and describe the physiology of the endocrine system
2.12 Identify the anatomy and describe the physiology of the lymphatic system
2.13 Identify the anatomy and describe the physiology of the mammary system

Care and Management

Secondary Benchmark:

Select and demonstrate best management practices for the care and management of animals

Post-Secondary Benchmark:

Evaluate best management production practices

Indicators:

3.1 Identify and evaluate animal species and breeds
3.2 Handle and move animals (e.g., training, restraint, confinement) with regard for safety of animals and handlers
3.3 Recognize and determine the impact of environmental factors on animals
3.4 Implement concepts of animal welfare and community expectations
3.5 Apply animal identification procedures (e.g., tagging, tattooing, ear notching, banding, branding, painting)

3.6 Guard and control animals against predators
3.7 Perform general animal care procedures (e.g., dehorning, castrating, trimming hooves, milking, weighing)

Health

Secondary Benchmark:

Select and implement a health care program

Post-Secondary Benchmark:

Develop and evaluate a health care program that meets the intended use of the animal

Indicators:

4.1 Evaluate general condition of animal
4.2 Identify symptoms of diseases, illnesses, parasites, and other health related problems
4.3 Implement disease prevention and health improvement program
4.4 Identify and implement (i.e., treat) treatment options
4.5 Interpret drug labels and prescriptions (e.g., ingredients, administration procedures, withdraw periods)
4.6 Determine and use appropriate/safe chemicals and products for sanitizing purpose
4.7 Identify the consequences of drugs and chemical misuse

Breeding and Reproduction

Secondary Benchmark:

Develop and implement a reproductive program to improve genetic traits

Post-Secondary Benchmark:

Develop and evaluate a selection, mating, and reproduction program that meets the intended use of the animal

Indicators:

5.1 Determine the role of genetics in animals
5.2 Identify reproductive methods and systems
5.3 Measure the genetic characteristics and phenotypes of breeding animals
5.4 Select animals for breeding programs based on species/breed standards
5.5 Practice breeding methods (e.g., artificial insemination, embryo transfer)
5.6 Practice ethical/responsible animal population control (i.e., spay, neuter, euthanasia)
5.7 Apply principles and practices of biotechnology to animal reproduction
5.8 Identify reproduction management practices (e.g., male to female ratios, age and weight for breeding, fertility and soundness for breeding, heat synchronization, flushing)

Grooming

Secondary Benchmark:

Select and perform grooming techniques

Post-Secondary Benchmark:

Evaluate various methods of grooming

Indicators:

6.1 Perform preparatory work on animal
6.2 Recognize oral and dermal problems

6.3 Control external parasites
6.4 Clip, scissor, and/or shear animals
6.5 Bathe animals
6.6 Trim claws and hooves
6.7 Execute finish grooming on animals

Plant Science

Standard Statement:

Applying principles of anatomy and physiology, nutrition, reproduction, and genetics to all phases in the production and/or management of plants in both a domesticated and natural environment. Planning, implementing, managing, and/or providing support services to the identification, selection, breeding, planting, fertilization, health, maintenance, and harvesting of plants and plant products.

Foundation Benchmarks: Students enrolled in a foundation program are expected to address all plant science principles and management practices identified in the standard. They will learn principles and management practices for recognized groups of plants found in agriculture, horticulture, forestry, and natural resources. The focus of instruction should be on those overarching principles and management practices related to the production and management of crops, landscapes, and forest and native plant populations.

Secondary Benchmarks: Students enrolled in a specialized workforce development program are expected to address the plant science principles and management practices identified in the standard. Students will apply the knowledge and skills to those plants addressed in their workforce development program. Students in Agricultural Business and Production Systems would learn and apply knowledge and skills to grain and oil crops, forages, and specialty crops. Students in Natural Resource Management would focus their studies on forest and native plant population management. Students in Horticulture would focus their studies on the production management, and application of nursery crops, turfgrasses, and ornamental plants. Instructional activities would focus on the principles and practices that cross all groups in the program rather than an in-depth focus on individual plant species.

Post-Secondary Benchmarks: Students enrolled in a post-secondary program are expected to address the plant science principles and management practices identified in the standard. Students will apply the knowledge and skills to specific plant species that are addressed in their major. For example, a crop science major would study principles and practices that cross all major crops (nutrition, reproduction, management, etc.) as well as the management practices related to specific crops such as soybeans, corn, alfalfa, etc.

Plant Nutrition

Secondary Benchmark:

Analyze and evaluate nutritional requirements and environmental conditions to develop and implement a fertilization plan

Post-Secondary Benchmark:

Develop and evaluate a fertilizer program using nutrient analysis techniques

Indicators:

1.1 Describe nutrient sources
1.2 Determine plant nutrient requirements and functions for optimum growth
1.3 Determine the environmental factors that influence and optimize plant growth
1.4 Describe nutrient application methods and appropriate practices

1.5 Apply nutrients to plants for economic growth
1.6 Collect and test soil and/or plant tissue
1.7 Interpret tests of soil and plant tissue

Reproduction

Secondary Benchmark:

Select, implement, and evaluate basic methods for reproducing and propagating plants

Post-Secondary Benchmark:

Analyze and evaluate reproduction methods using a full range of techniques

Indicators:

2.1 Determine the role of genetics in plants
2.2 Describe the functions of plant reproductive parts
2.3 Identify and practice methods of asexual/sexual plant propagation
2.4 Describe the principles of plant micro-propagation
2.5 Apply principles and practices of biotechnology to plant propagation

Plant Integrated Pest Management

Secondary Benchmark:

Develop and use a basic integrated pest management plan (e.g., prevention, treatment, control)

Post-Secondary Benchmark:

Evaluate an integrated pest management program

Indicators:

3.1 Identify plant pests (e.g., insects, diseases, weeds, rodents)
3.2 Determine pest management safety practices
3.3 Determine pest management methods
3.4 Develop pest management plans based on pest life cycles
3.5 Implement pest control plan with appropriate treatments
3.6 Evaluate pest control plan
3.7 Prevent, identify and manage pest resistance

Anatomy and Physiology

Secondary Benchmark:

Explain plant anatomy and physiology

Post-Secondary Benchmark:

Identify and explain the purpose and functions of plant anatomy and physiological systems

Indicators:

4.1 Identify plant structures (e.g., roots, stems, flowers, leaves, fruits, seeds)
4.2 Describe physiological functions of plants
4.3 Classify plants for taxonomical or other classifications

Growth and Production Management

Secondary Benchmark:

Plant and manage growth of crops/plants

Post-Secondary Benchmark:
Evaluate and implement management and production procedures

Indicators:
5.1 Identify and select seeds/plants
5.2 Manipulate and evaluate environmental conditions (e.g., irrigation, mulch, shading) to foster plant germination, growth, and development
5.3 Evaluate and demonstrate planting practices (e.g., population rate, germinate/seed vigor, inoculation, seed plant treatments, cuttings, and pot in pot)
5.4 Evaluate and demonstrate transplanting practices
5.5 Prepare soil /media for planting
5.6 Control plant growth (e.g., pruning, pinching, chemical, disbudding)
5.7 Determine maintenance schedule

Storage and Harvesting
Secondary Benchmark:
Harvest plants, store plant products, and analyze yields

Post-Secondary Benchmark:
Analyze and evaluate storage and harvesting methods and yields

Indicators:
8.1 Determine crop maturity
8.2 Identify harvesting practices and environmental conditions relative to harvesting
8.3 Demonstrate common harvesting techniques
8.4 Calculate yield and loss
8.5 Identify options for crop storage
8.6 Maintain quality of plant products in storage

Business Operations

Standard Statement:

Applying principles of economics and business management in both an entrepreneur/manager or employee role. Planning, implementing, managing, and/or providing support services to marketing, finance, human resource management, materials management, technologies and legal policies.

Foundation Benchmarks: Students enrolled in a foundation program are expected to address all business principles and management practices identified in the standard. The focus of instruction should be on those principles and practices related to basic business skills in all environmental and agricultural systems.

Secondary Benchmarks: Students enrolled in a specialized workforce development program are expected to address the business principles and management practices identified in the standard. Instructional activities should focus on the business principles and practices that pertain to your specific agricultural program, (i.e. agriculture, horticulture, or natural resources, etc.).

Post-Secondary Benchmarks: Students enrolled in a post-secondary program are expected to address the business principles and management practices identified in the standard. Students will apply the knowledge and skills to specific agricultural businesses that are addressed in their major.

Marketing

Secondary Benchmark:

Develop and apply a marketing plan for a product and/or service

Post-Secondary Benchmark:

Develop a comprehensive marketing plan for a business

Indicators:

1.1 Identify and evaluate methods of marketing products and services
1.2 Apply economic principles to marketing (e.g., supply and demand)
1.3 Research products and service design(s)
1.4 Merchandise products and services
1.5 Promote products and services
1.6 Advertise products and services
1.7 Identify and develop value-added products
1.8 Develop public relation campaigns
1.9 Develop a production plan

Management

Secondary Benchmark:

Analyze a business plan

Post-Secondary Benchmark:

Develop a comprehensive business plan using a full range of business principles

Indicators:

2.1 Identify types of businesses by legal structure
2.2 Identify capital resources
2.3 Identify organizational structures
2.4 Identify management types
2.5 Establish short and long term goals
2.6 Establish a mission statement
2.7 Develop business agreements
2.8 Identify, follow, and know consequences of local, state, and federal regulations
2.9 Perform human resource management functions (e.g., recruit, select, train, evaluate)
2.10 Maintain records (e.g., production, performance)

Finance

Secondary Benchmark:

Analyze and evaluate business finances

Post-Secondary Benchmark:

Integrate financial components into a business plan

Indicators:

3.1 Budget resources (e.g., capital, human, financial, time)
3.2 Manage assets for optimum utilization
3.3 Manage risk of liabilities
3.4 Evaluate credit uses and options
3.5 Analyze investment options (e.g., buy, lease, finance, risk)
3.6 Prepare and interpret financial statements (e.g., balance sheet, profit/loss statement, cash-flow statement)
3.7 Prepare tax forms (e.g., W-4, I9, depreciation, 1099, workers compensation)
3.8 Determine cost of doing business
3.9 Compare and examine advantages and disadvantages of banking procedures (e.g., bank reconciliation)

Business Leadership

Secondary Benchmark:

Develop and demonstrate business leadership techniques

Post-Secondary Benchmark:

Apply leadership skills to a business situation

Indicators:

4.1 Make business presentations
4.2 Identify time-management techniques
4.3 Develop educational and career goals
4.4 Use parliamentary law to make business decisions
4.5 Identify leadership styles
4.6 Develop relationships with peer groups and professional organizations

Sales and Customer Service

Secondary Benchmark:

Demonstrate customer service and sales techniques

Post-Secondary Benchmark:

Develop a customer service and sales program

Indicators:

5.1 Identify key components to organize a sale
5.2 Build and develop customer relationships
5.3 Conduct sales presentation
5.4 Provide post-sale service
5.5 Handle customer complaints
5.6 Develop sales goals and incentive programs
5.7 Prospect new customers

Technology Operations

Secondary Benchmark:

Demonstrate efficient use of technology

Post-Secondary Benchmark:

Analyze and demonstrate efficient use of technology

Indicators:

6.1 Operate leading technology (e.g., Global Positioning System [GPS], Geographical Information System [GIS], Personal Data Application [PDA], cellular)
6.2 Create and utilize documents using word processors, spreadsheets, databases, and electronic mail
6.3 Conduct research using the Internet
6.4 Conduct oral/visual presentation using presentation software

Materials Management

Secondary Benchmark:

Determine cost-effective materials management

Post-Secondary Benchmark:

Evaluate material control options

Indicators:

7.1 Plan and manage inventory
7.2 Apply just-in-time concepts
7.3 Calculate costs of carrying inventory
7.4 Perform logistics management

Issues

Secondary Benchmark:

Analyze issues affecting the industry

Post-Secondary Benchmark:

Determine, analyze, and present solutions for industry issues

Indicators:

8.1 Identify issues affecting industry
8.2 Research history, politics, and policies related to the issue
8.3 Identify conflicting points of view
8.4 Determine effects of the issue on the industry
8.5 Determine potential resolutions to the issue

Engineering

Standard Statement:

Applying principles of engineering to mechanical equipment, structures, biological systems, land treatment, power utilization, and technology. Planning, implementing, managing, and/or providing support services to facility design and construction, equipment design, manufacture, repair, and service; and agricultural technology.

Foundation Benchmarks: Students enrolled in a foundation program are expected to address the engineering principles and practices identified in the standard. They will learn and apply general principles of operation and maintenance to machines, equipment, and structures. The application of these general principles and practices will apply to those applications that cross all Environmental and Agricultural Systems programs.

Secondary Benchmarks: Students enrolled in a specialized workforce development program are expected to address the engineering principles and practices identified in the standard. Students will apply principles of maintenance and operation to machines, equipment and structural components commonly used in the industry most closely connected to their workforce development program. Only Agricultural and Industrial Mechanics programs would address all benchmarks in engines; power transmission; hydraulics; electricity; HVAC; and steering, suspension, and traction.

Students in Agribusiness and Production Systems would apply knowledge and skills to the machines, equipment, and structures used in the management of domesticated livestock, equine, companion animals, grain and oil seek crops, forages, and other specialty crops and animals. Students in Natural Resource Management would apply knowledge and skills to the machines, equipment, and structures used in the management of wildlife, fisheries, forests, and other native plant populations. Students in Horticulture programs would apply knowledge and skills to the machines, equipment, and structures used in nursery production, landscape design and maintenance, and the retail garden center trade. Instructional activities would likely focus on the general principles and practices that cross all machines, equipment, and structures in the program.

Post-Secondary Benchmarks: Students enrolled in a post-secondary program are expected to address the engineering principles and practices identified in the standard. Students will apply principles of maintenance and operation to machines, equipment, and structures commonly used in the industry most closely connected to their technical program major. Opportunities for in-depth application of knowledge and skills are expected.

Maintenance

Secondary Benchmark:

Maintain machinery and equipment

Post-Secondary Benchmark:

Solve maintenance problem situations involving machinery and equipment

Indicators:
1.1 Lubricate machinery and equipment
1.2 Ensure presence and function of safety systems and hardware
1.3 Service electrical systems
1.4 Perform machine adjustments (e.g., belts, clippers, drive chains)
1.5 Service filtration systems
1.6 Maintain fluid levels
1.7 Maintain machinery and equipment cleanliness and appearance
1.8 Maintain fluid conveyance components, (e.g., hoses and lines, valves, nozzles)
1.9 Design a preventative maintenance schedule
1.10 Identify causes of malfunctions and failures
1.11 Calibrate metering, monitoring, and sensing equipment

Operation
Secondary Benchmark:
Operate machinery and equipment
Post-Secondary Benchmark:
Analyze machine functions by investigating operational options
Indicators:
2.1 Describe function of machine controls and instrumentation
2.2 Perform appropriate start-up procedures
2.3 Select proper machine(s) for specific task(s)
2.4 Safely operate equipment
2.5 Perform pre-operation inspection
2.6 List applicable laws for on and off highway operation
2.7 Load equipment and materials

Vehicle Performance
Secondary Benchmark:
Service and repair steering, suspension, traction, and vehicle performance systems
Post-Secondary Benchmark:
Evaluate and design steering, suspension, traction, and vehicle performance systems
Indicators:
8.1 Evaluate traction, ballasting, and weight transfer
8.2 Evaluate vehicle stability

Design
Secondary Benchmark:
Design and plan structures equipment, and facilities
Post-Secondary Benchmark:
Develop and analyze plans for structures, equipment, and facilities
Indicators:
9.1 Analyze site/equipment/permit/local code requirements
9.2 Develop sketches, drawings, and/or blueprints

9.3 Estimate material needs and costs
9.5 Identify and select materials used in construction/fabrication
9.6 Identify and select fasteners and hardware (e.g., screws, nails, glue, rivets, hinges)
9.7 Establish the sequential steps of construction

Construction

Secondary Benchmark:

Construct structures and facilities

Post-Secondary Benchmark:

Evaluate and design agricultural facilities

Indicators:

10.1 Construct with wood (e.g., layout, cut, smooth, shape, bore, hold and join)
10.2 Construct with metal (e.g., layout, cut, prep, bend, shape, bore, hold and join)
10.3 Identify and maintain hand and power tools (e.g., sharpen, clean, repair)
10.4 Install plumbing equipment and fixtures
10.5 Install electrical wiring components and fixtures
10.6 Prepare surfaces and select and apply coatings
10.7 Insulate facility
10.8 Install fencing

Surveying & Mapping

Secondary Benchmark:

Non-applicable

Post-Secondary Benchmark:

Use technological tools to map land, facilities, and infrastructure

Indicators:

11.2 Read maps
11.3 Utilize surveying skills
11.4 Perform site measurements
11.5 Draft maps

Structural Engineering Fundamentals

Secondary Benchmark:

Evaluate materials used in construction applications

Post-Secondary Benchmark:

Compare and contrast various materials used in structural engineering

Indicators:

13.1 Measure environmental and agricultural objects using standard and metric systems (i.e., length, volume, mass, temperature)
13.2 Compare and contrast the structural properties, grades, and types of wood and wood products

Environmental Science

Standard Statement:

Applying principles of environmental safety, health, and wise use of renewable and non-renewable resources. Planning, implementing, managing, and/or providing support services to soil, air, and water management; land use planning; watershed management and protection; water treatment; waste treatment; pollution control; land treatment, and recreational use of natural resources.

Foundation Benchmarks:

Students enrolled in a foundation program are expected to address the principles and practices identified in the standard. They will learn general principles of environmental safety, health, and wise use of renewable and non- renewable resources. Focus of instruction will be on the general application of principles to situations that cross all industries in agricultural and environmental systems.

Secondary Benchmarks:

Students enrolled in a specialized workforce development program are expected to address the Environmental Science principles and practices identified in the standard. Students enrolled in Agribusiness and Production Systems, Horticulture, and Natural Resource Management will apply principles of environmental science as they pertain to air, land, water, ecosystems, waste management, and contaminants, commonly used in the industry most closely connected to their workforce development program. Its is anticipated that only Natural Resource Management programs would address benchmarks in land use planning, watershed management and protection, water treatment, pollution control, land treatment, wildlife management and recreational use of natural resources.

Post- Secondary Benchmarks:

Students enrolled in post-secondary programs are expected to address the Environmental Science principles and practices identified in the standard. Students will apply principles of environmental safety, health, and the wise use of renewable and non-renewable resources commonly used in the industry most closely connected to their technical program major. Opportunities for in-depth application of knowledge and skills are expected.

Land

Secondary Benchmark:

Apply soil management practices based on key fundamentals of soils

Post-Secondary Benchmark:

Develop soil management programs using all fundamentals of soil

Indicators:

1.1 Determine the physical and chemical properties of soils and growing medium
1.2 Inventory soils
1.3 Determine land use requirements
1.4 Develop soil conservation program

1.5 Demonstrate techniques that reduce soil erosion
1.6 Evaluate land use limitations (e.g., septic systems, drainage, agriculture, and socio economic considerations)

Water

Secondary Benchmark:

Develop a water quality management plan for a property using basic water quality characteristics

Post-Secondary Benchmark:

Develop a water quality and watershed management program using all water quality characteristics

Indicators:

2.1 Determine the chemical and physical properties of water and biological Indicators: of water quality
2.2 Explain the hydrological cycle
2.3 Explain the factors affecting water quality
2.4 Monitor water quality and quantity
2.5 Define, delineate, and assess watersheds and streams

Ecosystems

Secondary Benchmark:

Develop an ecosystem management plan for natural resources and the environment

Post-Secondary Benchmark:

Develop an ecosystem management program for natural resources and the environment

Indicators:

3.1 Explain basic ecological principles and cycles
3.2 Explain plant and animal interactions with the abiotic (non-living) environment
3.4 Contrast/compare characteristics of different ecosystems (e.g., pond, stream, crop lands, open land, brushlands, woodlands, wetlands)
3.5 Evaluate habitats for best management practices

Contaminates

Foundation Benchmark:

Define and identify contaminants

Secondary Benchmark:

Identify sources of contaminants

Post-Secondary Benchmark:

Describe potential contaminants and their impact on the environment

Indicators:

4.1 Determine types, sources, and impact of contaminates
4.2 Explain programs and policies related to contaminates
4.3 Demonstrate contaminates control and prevention practices
4.4 Monitor levels of contaminates

Air

Secondary Benchmark:

Develop an air quality management plan for major components (using major elements in air quality)

Post-Secondary Benchmark:

Develop an air quality management program using all components (elements) in air quality

Indicators:

5.3 Explain factors affecting air quality
5.4 Monitor air quality and quantity

Emergency Response

Secondary Benchmark:

Identify and comply with all components of an emergency plan

Post-Secondary Benchmark:

Develop components of an emergency response plan

Indicators:

7.4 Identify various emergency response plans
7.5 Develop an emergency response plan (e.g., agricultural leakage, chemical spills, natural disasters)

Waste Management

Secondary Benchmark:

Not Applicable

Post-Secondary Benchmark:

Apply principles of solid waste management (landfill) to manage safe disposal of all categories of waste

Indicators:

12.1 Collect and treat waste materials
12.2 Identify the risks associated with solid waste accumulation and disposal
12.3 Describe methods of site identification and acceptance
12.4 Describe the process of waste decomposition
12.6 Describe waste management methods (e.g., composting facility, incinerate waste, recycling)

Hazardous Materials Management

Secondary Benchmark:

Use, store, and dispose of non-restricted hazardous materials

Post-Secondary Benchmark:

Apply hazardous materials management principles assure a safe facility and to comply with applicable regulations

Indicators:

15.1 Describe health and safety practices to reduce risks from hazardous materials
15.3 Demonstrate an ability to obtain and use information addressing hazardous substance release
15.4 Demonstrate safe handling procedures for hazardous materials and hazardous waste
15.6 Perform site evaluation
15.8 Prepare hazardous materials for transportation and storage in accordance with regulations

Wetlands Management

Secondary Benchmark:

Not Applicable

Post-Secondary Benchmark:

Discuss properties, classifications and functions in order to understand wetland principles

Indicators:

16.1 Identify properties of wetlands
16.2 Explain wetlands classification
16.3 Explain the function of wetlands

Geographic Information Systems (GIS)

Secondary Benchmark:

Post-Secondary Benchmark:

Use Geographic Information System/Global Positioning System (GIS/GPS) applications

Indicators:

17.1 Interpret and evaluate accuracy of aerial photographs

Appendices

Appendix A

Business & Industry Review Panels

Ohio College Tech Prep Business & Industry Review Panels

Clell Agler, Buckeye Building Systems, Grove City
Daryl Bauman, Shearer Equipment Company, Wooster
Gary Besancon, Agri Mark, Smithville
David Bishop, Turk Brothers Custom Meats, Ashland
Terry Bonar, Canterbury Golf Club, Beachwood
Russell Breyley, Windy Ridge Pheasant Farm, Tiro
Scott Briggs, Tuscarawas Soil &Water Conservation District (SWCD), New Philadelphia
Larry Craft, Town & Country Co-op, Inc., Lagrange
David Donner, Donner Landscaping, Hinckley
Ron Dues, R. J. Dues, Inc., St. Henry
Daniel Erwin, Erwin Family Farms, Richwood
Daniel Flory, Curry Lumber, Wooster
Ed Folk, Retired, Ohio Department of Natural Resources, Wildlife Division, Coshocton
Tami Galliher, The Ohio State University, Ohio Agriculture, Research & Developmental Center (OARDC), Wooster
Randy Geiser, Maibach Tractor, Creston
Richard F. Gooding, Goodings Nursery & Landscaping, Sherrodsville
Ed Harper, Workforce Development Council Tech Prep Consortium, Fremont
Bill Haynes, DVS, Inc., Winchester
Roger Inkrott, Kalmbach Feeds, Inc., Wooster
Mark Jordan, Westfield Group Country Club, Center
Keith Kelley, Uncle Mike's Country Cured Meats, Wooster
Doug Knudsen, Fishbaugh Construction, Greenwich
Lola Lewis, Ohio Department of Natural Resources, Division of Forestry, New Philadelphia
Larry Lokai, Ohio Seed Improvement Association, Inc., Urbana
Alph Mailbach, W. G. Dairy Supply, Inc., Creston
Bob McClure, Ruff's Seed Farm, Lancaster
Arline L. Mercer, Plain City Florist, Plain City
Keith Miller, Horrisberger Implement, Walnut Creek
Karen Milley, J. M. Smuckers Company, Orrville
Jeff Neuhauser, Smith Dairy, Orrville
Roger Nicol, Land O'Lakes, Inc., Marysville
Sue Perry, J. M. Smuckers Company, Orrville
Rob Peters, Stark County Park District, Canton
Wesley Pitt, Wesley Pitt Quarter Horses, Bucyrus
Edwin Powell, Mount Victory Meats, Mt. Victory

Regina Powell, Mount Victory Meats, Mt. Victory
Melissa Reisinger, Animal Medical Centre, Medina
Floyd Robinson, Mast Lepley, Apple Creek
Tom Roig, T&B Landscapes, Shreve
Brad Ross, Ohio Department of Natural Resources, Division of Soil & Water Conservation, Columbus
Kathy Saxton, Meegan Kennels, Pataskula
Suzy Schmidt, Jack's Aquarium & Pets, Columbus
Jeff Shaffstall, Hehn's Wholesale Greenhouse, Copley
Lynn Smith, Champaign Landmark, Mt. Victory
Tom Stoller, TMS Stoller Tractor, Sterling
Ray Stoneburner, Stoneburner Enterprises, Inc., Amanda
Robert Studeny, Ashland Florist & Greenhouse, Ashland
John Tucker, Tucker Packing Company, Orrville
Don VanNostran, Mid-State Wool Growers, Canal Winchester
Mel Wenger, Orrville Veterinary Clinic, Inc., Orrville
Duane Wood, Wayne Soil &Water Conservation District (SWCD), Wooster
Michele Wood, Holmes Soil & Water Conservation District (SWCD), Millersburg
Nathan Wright, Geophyta, Inc., Vickery
Brenda Young, Mid-Wood, Inc., Fostoria

Appendix B

Educator Review Panels

Ohio College Tech Prep Educator Review Panels

Glenn Abke, Owens Community College, Toledo
Monte Anderson, Wilmington College, Wilmington
Don Barnhart, Leipsic High School, Leipsic
Wayne Barter, Wayne County Career Center, Smithville
Roger Baur, The Ohio State University, Agricultural Technical Institute, Wooster
Doug Beck, Coldwarer High School, Coldwater
Cathy Billock, Trumble County Career Center, Warren
Michael Borger, The Ohio State University, Agricultural Technical Institute, Wooster
Cyndi Brill, Canal Winchester High School, Canal Winchester
Rich Brill, Canal Winchester High School, Canal Winchester
Harold Brown, The Ohio State University, Plant Pathology, Horticulture & Crop Science, Columbus
Jamie Cano, The Ohio State University, Department of Human & Community Resource Development, Columbus
Wendy Chrisman, Indian Valley High School, Gnadenhutten
Chris Clark, Madison Plains Schools, London
Lisa Clevenger, Twin Valley South High School, West Alexandria
Gary Coffing, The Ohio State University, Agricultural Technical Institute, Wooster
Penny Collins, Toledo Agricultural Education Center, Toledo
Karen J. Cooley, Pymatuning Valley High School, Andover
Larry Coon, Hocking College, Nelsonville
Brian Crapo, Seneca East High School, Attica
Anna Creswell, Hardin Northern High School, Dola
Robin Curley, Ohio Hi-Point Career Center, Bellefountaine
Bob Daniels, West Muskingum High School, Zanesville
Roger Davis, New Lexington High School, New Lexington
Tracy Dendinger, Miami Trace High School, Washington Court House
Diane DeYonker, Toledo Agricultural Education Center, Toledo
Claire Ehrlinger, Cincinnati State College, Cincinnati
Susan Everett, Clark State Community College, Springfield
Dennis Finley, R. G. Drage Career Technical Center, Massillon
Ken Fliehman, East Clinton High School, Lees Creek
Ronald Gillette, University of Northwestern Ohio, Lima
Daryl Goodwin, Greenville High School, Greenville
Greg Gordon, The Ohio State University, Agricultural Technical Institute, Wooster
Cynthia Grassbaugh, Big Walnut High School, Sunbury
Thomas Green, Marlington High School, Alliance

Tom Hackenbracht, Buckeye Career Center, New Philadelphia
Elissa M. Heal, Sentinel Career Center, Tiffin
Kim Jones, Medina County Career Center, Medina
Brian Kennedy, Eastland Career Center, Groveport
Patrick Knoble, Wellington High School, Wellington
Bill Kucic, Pioneer Career and Technical Center, Shelby
Neil Lehnhart, Teays Valley High School, Ashville
Fred Lendrum, The Ohio State University, Agricultural Technical Institute, Wooster
John Marks, Muskingum Area Technical College, Zanesville
Roy Marks, Owens Community College, Toledo
Robert McMahon, The Ohio State University, Agricultural Technical Institute, Wooster
Jack Mescher, Coldwater High School, Coldwater
Rick C. Metzger, Westfall High School / Pickaway-Ross Career Technical Center, Williamsport
M. Keith Motter, Fort Loramie High School / Upper Valley Joint Vocational School Satellite, Piqua
David Munn, The Ohio State University, Agricultural Technical Institute, Wooster
John Oliver, Marlington High School, Alliance
Bill Peneston, Hocking College, Nelsonville
John Poulson, Pettisville High School, Pettisville
Dave Reese, Liberty-Benton High School, Findlay
Jim Rich, River View High School, Warsaw
Scott Ripley, Buckeye Career Center, New Philadelphia
Jim Ritter, Tri-Rivers Career Center, Marion
Joanne Scudder, Washington Park Horticulture Center, Cleveland
Larry Seibel, Miami Valley Career Technical Center, Clayton
Pam Snider, Northwest Career Center, Dublin
Dave Snyder, Ashland High School, Ashland
William Spiess, Four County Career Center, Archbold
Royce Thornton, The Ohio State University, Agricultural Technical Institute, Wooster
Wayne Weber, Monroeville High School, Monroeville
Jeff Weeks, Upper Valley Joint Vocational School, Piqua
Kim Weiss, Benjamin Logan High School, Bellefontaine
Craig Wellert, Wayne County Career Center, Smithville
Debbie Woodworth, Mentor High School, Mentor
Barrett Zimmerman, Clyde High School, Clyde

Appendix C

College Tech Prep Pathway Template

(High School)

(Career Center)

(Community College)

College Tech Prep Program

(School Year)

9th GRADE	CREDIT	10th GRADE	CREDIT	11th GRADE	CREDIT	12th GRADE	CREDIT

Recommended Prerequisites for Grade 11 of Tech Prep	Recommended for College Portion of Tech Prep

Junior Year Tech Center/College Technical Courses		Senior Year Tech Center/College Technical Courses	
*Technical Subjects	On-transcript _____ College Credits	*Technical Subjects	_____ College Credits

Articulated Credits: -_____ Community College

This template is used to facilitate Ohio College Tech Prep Pathways and is submitted by the Ohio College Tech Prep Consortium with the application.
Revised 6/20/03

DEGREE: ASSOCIATE OF _____

_____ - College Tech Prep _____

(Career Center) (Name of College Tech Prep Program)

Term Taken	First Term	Pre-requisite	Co-requisite	Quarter Credit Hours	University Pathway Equivalent	Completed as Tech Prep Component
Term Taken	**Second Term**	**Pre-requisite**	**Co-requisite**			
Term Taken	**Third Term**	**Pre-requisite**	**Co-requisite**			

Revised 6/20/03

DEGREE: ASSOCIATE OF _____

_____ - **College Tech Prep** _____
(Career Center) (Name of College Tech Prep Program)

Term Taken	Fourth Term	Pre-requisite	Co-requisite	Quarter Credit Hours	University Pathway Equivalent	Completed as Tech Prep Component
Term Taken	**Fifth Term**	**Pre-requisite**	**Co-requisite**			
Term Taken	**Sixth Term**	**Pre-requisite**	**Co-requisite**	**Quarter Credit Hours**	**University Pathway Equivalent**	**Completed as Tech Prep Component**

_____ **Total Quarter Credit Hours**

Revised 6/20/03

Appendix D

Agricultural & Environmental Systems Career List

Educational Programs and Careers

Agricultural and Environmental Systems
Agricultural Business and Production Systems
Educational Programs and Careers

- **INDUSTRY SECTOR**
  - **Career Field**
    - **Educational Program**
    - **Career**
    - **Career, Non Tech Prep**

- **ANIMAL HEALTH**
  - **Agricultural and Domestic Animal Services Career Field**
    - Animal Health Products and Feed Distributor Representative
    - Animal Health Products Sales Representative
    - Artificial Breeding Distributor
    - Companion Animal Veterinarian
    - Embryo Transfer Specialist
    - Equine Veterinarian
    - Insect and Disease Inspector
    - Large Animal Veterinarian
    - Poultry Veterinarian
    - Product Research Veterinarian (lot animal, research)
    - Teaching Veterinarian
    - Veterinary Assistant and Aide
    - Veterinary Inspector
    - Veterinary Inspector Aide
    - Veterinary Laboratory Technician
    - Veterinary Practice Manager
    - Veterinary Technicians and Technologist
    - Veterinary X-ray Technician
  - **Veterinary Biomedical and Clinical Sciences Career Field**
    - Blood Tester
    - Environmental Toxicologist
    - Equine Veterinarian
    - Poultry Veterinarian
    - Radiologist
    - Veterinary Bacteriologist
    - Veterinary Dentist
    - Veterinary Epidemiologist
    - Veterinary Orthopedic Surgeon
    - Veterinary Parasitologist
    - Veterinary Pathologist
    - Veterinary Pharmacologist
    - Veterinary Virologist
    - Veterinary Virus-Serum Inspector

- **ANIMAL HEALTH**
  - **Agricultural and Domestic Animal Services Career Field**
    - **Veterinary Medicine**. Individuals focus on the independent professional practice of veterinary medicine, involving the diagnosis, treatment, and health care management of animals and animal populations and the prevention and management of zoonosis. Individuals are expected to apply veterinary basic sciences, infectious and noninfectious disease, diagnostic procedures, veterinary clinical medicine, obstetrics, radiology, anesthesiology, surgery, toxicology, animal health and preventive medicine, clinical nutrition, practice management, and professional standards and ethics.
    - **Veterinary/Animal Health Technology/Technician and Veterinary Assistant.** Individuals work under the supervision of veterinarians, laboratory animal specialists, and zoological professionals, to provide patient management, care, and clinical procedures assistance as well as owner communication. Individuals are expected to apply animal nursing care, animal health and nutrition, animal handling, clinical pathology, radiology, anesthesiology, dental prophylaxis, surgical assisting, clinical laboratory procedures, office administration skills, patient and owner management, OSHA compliance and applicable standards and regulations.
  - **Veterinary Biomedical and Clinical Sciences Career Field**
    - **Comparative and Laboratory Animal Medicine**. Individuals focus on the scientific study of animal models of human disease and related experimental procedures, and prepare veterinarians and animal health specialists to manage the laboratory use and care of experimental animals. Individuals are expected to apply laboratory animal husbandry, laboratory animal disease, biohazard control, gnotobiology, breeding, comparative anatomy and physiology, comparative gene mapping, protein function, physical and mathematical modeling, computer modeling, stem cell technology, colony and genetic stock management, cryopreservation, applicable regulations, and bioethics.
    - **Large Animal/Food Animal and Equine Surgery and Medicine.** Individuals focus on the scientific study of the internal medicine and invasive and noninvasive treatment of herd, work, sport, and food animals. Individuals are expected to apply equine medicine, swine and dairy medicine, food animal medicine, pathophysiology, large animal diseases, large animal anesthesiology and surgical procedures, preoperative and postoperative care, and specific medical specialties such as dentistry, ophthalmology, oncology, obstetrics/theriogenology, radiology and orthopedics.
    - **Small/Companion Animal Surgery and Medicine.** Individuals focus on the scientific study of the internal medicine and invasive and noninvasive treatment of companion and household animals. Individuals are expected to apply avian medicine, pet care, companion animal medicine, pathophysiology, small animal diseases, small animal anesthesiology and surgical procedures, preoperative and postoperative care, and specific medical specialties such as dentistry, ophthalmology, oncology, obstetrics/theriogenology, radiology, and orthopedics.
    - **Veterinary Anatomy**. Individuals focus on the scientific study of the structure of small and large animal cellular, organ, tissue, and body systems and their relation to physiologic function, disease, and therapeutic treatment. Individuals are expected to apply histology, ultrastructure, molecular biology, biochemistry, developmental biology, neuroscience, electrophysiology, electron microscopy, computer imaging, and applications to specific species.

- **Veterinary Infectious Diseases**. Individuals focus on the scientific study of zoonotic infectious diseases, disease mechanisms, and prevention and treatment strategies. Individuals are expected to apply disease pathogenesis, vector biology, mycobacterial infection, blood parasites, retroviruses, food-borne diseases, new infectious agents, ecotoxicology, mechanisms of disease transfer, antibody resistance, comparative pathology, communicable diseases, and disease prevention and eradication.
- **Veterinary Microbiology and Immunobiology**. Individuals focus on the scientific study of the microbial causation and immunology processes related to animal disease, prevention, and treatment. Individuals are expected to apply bacteriology, mycology, virology, immune response mechanisms, humoral and cell function, cancer defenses, immune system dysfunction, immunologic diseases, parasitology, pathogenesis, and disease vectors.
- **Veterinary Pathology and Pathobiology**. Individuals focus on the scientific study of the development and process of disease in domestic and wild animals and applications to diagnosis, prevention, and treatment. Individuals are expected to apply pathogenesis, immunoparasitology, viral therapy, inherited metabolic diseases, environmental toxicology, anatomical and clinical pathology, necropsy and biopsy techniques, clinical laboratory analysis, pathological interpretation, and disease diagnosis.
- **Veterinary Physiology**. Individuals focus on the scientific study of the functional dynamics of animal biological systems and their relationship to the diagnosis and treatment of disease and injury. Individuals are expected to apply mammalian and non-mammalian physiology, laboratory physiology, physiological responses to the environment, endocrinology, animal biotechnology, mechanisms of hormone action, organ systems, metabolism, and pathophysiology.
- **Veterinary Preventive Medicine Epidemiology and Public Health.** Individuals focus on the study of the prevention and control of communicable animal diseases, diseases affecting humans, and prepare veterinarians to function as public health specialists. Individuals are expected to apply animal epidemiology, biostatistics, food safety and quality assurance, food toxicology, zoonotic and infectious diseases, disease vectors and transference, production medicine, animal health, veterinary public health practice, and inspection and evaluation methods.
- **Veterinary Toxicology and Pharmacology**. Individuals focus on the scientific study of specific environmental and food hazards affecting domestic and wild animals and the development and action of chemical antidotes and treatments. Individuals are expected to apply small and large animal toxicology and pharmacology, neurotoxicology, pharmacodynamics, pharmacokinetics, neuropharmacology, xenobiotics, drug resistance, pesticides, toxicological pathology, genetic and molecular toxicology, environmental toxicology, drug and toxicant analysis and evaluation, and environmental radiology.

- **ANIMAL SYSTEMS**
  - **Agricultural Business and Management Career Field**
    - Agricultural Business Accountant
    - Agricultural Business Manager
    - Agricultural Loan Officer
    - Field Representative for Bank, Insurance Company or Government Programs
    - Land Bank/Farm Credit Service Manager

❖ **Agricultural Operations Career Field**
- Agricultural Land Appraiser/Sales
- Animal Breeder
- o Animal Caretaker
- Aqua Culture Specialist
- Aquaculture Producer/Operator/Manager
- Artificial Insemination Herd Sire Technician
- Beef Producer/Operator Manager
- o Blacksmith
- Dairy Herd Supervisor (DHIA)
- Dairy Producer/Business Operator
- o Egg Grader/ Marketer
- Equine Producer/Business Operator/Manager
- o Ferrier
- Herd Sire Evaluator
- Herd Sire Manager
- o Livestock Auctioneer
- Livestock Commission Agent
- o Livestock Farm worker, Laborer, Farm Hand, Yard Attendant
- o Livestock Herdsperson
- Livestock Machinery and Equipment Sales Representative/Dealer
- Livestock Sales Representative
- Livestock Seller/Buyer/Appraiser
- Manager Information Systems Specialist (MIS)
- Meat Buyer
- Poultry Hatchery Manager
- Poultry Producer/Business Operator Manager
- Product Commission Agent
- Recovery/Rehabilitation Manager
- Semen Processing Specialist
- Sheep Producer/Business Operator
- Specialty Animal Producer/Operator/Manager
- Swine Producer/Business Operator
- Technology Systems Manager
- o Wool Grader/buyer
- o Wool Shearer, Stock Clipper

❖ **Animal and Poultry Science Career Field**
- Animal Nutritionist
- Animal Production Scientist/Specialist
- Animal Reproduction Scientist/Specialist
- Animal Welfare Specialist/Consultant
- Aquaculture Scientist/Specialist
- Beef Scientist/Specialist
- Dairy Scientist/Specialist
- Equine Scientist/Specialist
- Feed and Farm Management Adviser/Analyst
- Laboratory Technician/Research Aide
- Poultry Breeding Scientist/Specialist
- Poultry Scientist/Specialist

- Sheep Scientist/Specialist
- Specialty Animal Scientist/Specialist
- Swine Scientist/Specialist

❖ **Domestic Animal Services Career Field**

- Behavior Modification Specialist
- Equine Trainer
  - Fitter/Groomer
  - Horse Exerciser
  - Paddock Judge
  - Professional Show Person
- Race Horse Trainer
  - Stable Attendant Groomer Stallion Manager
- Stable Manager
  - Stallion Manager

❖ **Zoology/Animal Biology Career Field**

- Animal Cytologist
- Animal Ecologist
- Biochemist
- Biotechnologist
- DNA - Gene Targeting/Gene Mapping
- Genetic Importer
- Muscle Biology Researcher
- Population Genetics Specialist
- Reproductive Physiologist

♦ **ANIMAL SYSTEMS**

❖ **Agricultural Production Operations Career Field**

➢ **Agricultural Production Operations, General.** Individuals focus on the general planning, economics, and use of facilities, natural resources, equipment, labor, and capital to produce plant and animal products, and that may prepare individuals for work in farming, ranching, and agribusiness.

➢ **Animal/Livestock Husbandry and Production**. Individuals select, breed, care for, slaughter, and market livestock and small farm animals. Individuals are expected to apply basic animal science, animal nutrition, and animal health as applied to various species and breeds; design, management and operation of housing, feeding, and handling facilities; and related issues of safety, applicable regulations, logistics, and supply.

➢ **Dairy Husbandry and Production**. Individuals manage the selection and care of dairy animals and associated dairy farm and processing facilities and operations. Individuals are expected to apply basic animal and dairy science; dairy animal nutrition and health; design and operation of dairy housing, feeding, and processing facilities and equipment; and related issues of safety, sanitation, shipping and handling, and applicable regulations.

➢ **Horse Husbandry/Equine Science and Management**. Individuals manage the selection, breeding, care, and maintenance of work, athletic, and show horses; and horse farms, stables, tracks and related equipment and operations. Individuals are expected to apply principles of animal science, care, and health; stable and track management; design and operation of facilities and equipment; and related issues such as regulations, business management; and logistics.

- **Animal Sciences Career Field**
  - **Agricultural Animal Breeding**. Individuals focus on the application of genetics and genetic engineering to the improvement of agricultural animal health, the development of new animal breeds, and the selective improvement of agricultural animal populations. Individuals are expected to apply genetics, genetic engineering, population genetics, animal health, animal husbandry, and biotechnology.
  - **Animal Health**. Individuals focus on the application of biological and chemical principles to the study, prevention, and control of diseases in agricultural animal populations. Individuals are expected to apply environmental science, pharmacology, animal population studies, genetics, animal physiology and diet, disease prevention, treatment methodologies, and laboratory and testing procedures.
  - **Animal Nutrition**. Individuals focus on the biology and chemistry of proteins, fats, carbohydrates, water, vitamins, and feed additives as related to animal health and the production of improved animal products. Individuals are expected to apply nutrition science, animal health and physiology, biochemistry, cellular and molecular biology, animal husbandry, and food science.
  - **Animal Sciences, General**. Individuals focus on the scientific principles that underlie the breeding and husbandry of agricultural animals, and the production, processing, and distribution of agricultural animal products. Individuals are expected to apply animal sciences, animal husbandry and production, and agricultural and food products processing.
  - **Bioinformatics.** Individuals focus on the application of computer-based technologies and services to biological, biomedical, and biotechnology research. Individuals are expected to apply algorithms, network architecture, principles of software design, human interface design, usability studies, search strategies, database management and data mining, digital image processing, computer graphics and animation, CAD, computer programming, and applications to experimental design and analysis and to specific quantitative, modeling, and analytical studies in the various biological specializations.
  - **Biometry/Biometrics**. Individuals focus on the application of statistics and other computational methods to the study of problems in the biological sciences and related fields in agriculture and natural resources. Individuals are expected to apply computational biology, mathematical statistics, matrix algebra, applied calculus, experimental design, linear modeling, sampling theory, stochastic processes, spatial and temporal analysis, longitudinal analysis, sparse/unbalanced data and complex error, and applications to such topics as population genetics, animal breeding, forest genetics, population dynamics, wildlife biometry, ecology, and agricultural and natural resource management.
  - **Biotechnology**. Individuals focus on the application of the biological sciences, biochemistry, and genetics to the preparation of new and enhanced agricultural, environmental, clinical, and industrial products, including the commercial exploitation of microbes, plants, and animals. Individuals are expected to apply bioinformatics, gene identification, phylogenetics and comparative genomics, bioinorganic chemistry, immunoassaying, DNA sequencing, xenotransplantation, genetic engineering, industrial microbiology, drug and biologic development, enzyme-based production processes, patent law, biotechnology management and marketing, applicable regulations, and biotechnology ethics.
  - **Dairy Science**. Individuals focus on the application of biological and chemical principles to the production and management of dairy animals and the production

and handling of dairy products. Individuals are expected to apply animal sciences, nutrition sciences, food science and technology, biochemistry, and related aspects of human and animal health and safety.

- **Human Nutrition.** Individuals focus on the relationships between food consumption and human development and health. Individuals are expected to apply the cellular and molecular processes of food processing in the human body, related metabolic processes, the relationship of food and nutrition to disease, and nutritional needs across the life span.
- **Livestock Management**. Individuals focus on the application of biological and chemical principles to the production and management of livestock animals and the production and handling of meat and other products. Individuals are expected to apply animal sciences, nutrition sciences, food science and technology, biochemistry, and related aspects of human and animal health and safety.
- **Nutrition Sciences**. Individuals focus on the utilization of food for human growth and metabolism, in both normal and dysfunctional states, from the interdisciplinary perspective of the agricultural, human, biological, and biomedical sciences. Individuals are expected to apply food science, biochemistry, physiology, dietetics, food and nutrition studies, biotechnology, biophysics, and the clinical sciences.

❖ **Agricultural and Domestic Animal Services Career Field**

- **Equestrian/Equine Studies.** Individuals focus on the horse, horsemanship, and related subjects and prepare individuals to care for horses and horse equipment; ride and drive horses for leisure, sport, show, and professional purposes; and manage the training of horses and riders. Individuals are expected to apply horse breeding, nutrition, health, and safety; history of the horse and horsemanship; horse development and training; riding and equestrian technique; stable, paddock, and track management; and equipment maintenance and repair.

❖ **Zoology/Animal Biology Career Field**

- **Animal Physiology.** Individuals focus on the scientific study of function, morphology, regulation, and intercellular communications and dynamics within vertebrate and invertebrate in animal species, with comparative applications to Homo sapiens and its relatives and antecedents. Individuals are expected to apply reproduction, growth, lactation, digestion, performance, behavioral adaptation, sensory perception, motor action, phylogenetics, biotic and abiotic function, membrane biology, and related aspects of biochemistry and biophysics.
- **Zoology/Animal Biology**. Individuals focus on the scientific study of the biology of animal species and phyla, with reference to their molecular and cellular systems, anatomy, physiology, and behavior. Individuals are expected to apply molecular and cell biology, microbiology, anatomy and physiology, ecology and behavior, evolutionary biology, and applications to specific species and phyla.

❖ **Genetics Career Field**

- **Animal Genetics**. Individuals focus on the scientific study of the genetics of multicellular animal life forms from the experimental, comparative, and clinical (veterinary and medical) viewpoints. Individuals are expected to apply molecular genetics, gene expression, gene regulation, genomics, epigenetic phenomena, DNA recombination and repair, genetic interactions at the microbial and higher levels, and molecular evolution.

❖ **Agricultural Business and Management Career Field**

- **Agricultural/Farm Supplies Retailing and Wholesaling**. Individuals sell agricultural products and supplies, provide support services to agricultural

enterprises, and purchase and market agricultural products. Individuals are expected to apply basic business management, marketing, retailing and wholesaling operations, and applicable principles of agriculture and agricultural operations.

- **Agribusiness/Agricultural Business Operations**. Individuals manage agricultural businesses and agriculturally related operations within diversified corporations. Individuals are expected to apply agriculture, appropriate agricultural specialization, business management, accounting, finance, marketing, planning, human resources management, and other managerial responsibilities.
- **Agricultural Business and Management, General**. Individuals focus on modern business and economic principles involved in the organization, operation, and management of agricultural enterprises.
- **Agricultural Business Technology**. Individuals perform specialized support functions related to agricultural business offices and operations and to operate agricultural office equipment, software, and information systems. Individuals are expected to apply basic agricultural business principles, office management, equipment operation, standard software, and database management.
- **Agricultural Economics.** Individuals focus on the application of economics to the analysis of resource allocation, productivity, investment, and trends in the agricultural sector, both domestically and internationally. Individuals are expected to apply economics and related subfields as well as applicable agricultural fields.
- **Applied Economics**. Individuals focus on the application of economic principles and analytical techniques to the study of particular industries, activities, or the exploitation of particular resources. Individuals are expected to apply economic theory; microeconomic analysis and modeling of specific industries, commodities; the economic consequences of resource allocation decisions; regulatory and consumer factors; and the technical aspects of specific subjects as they relate to economic analysis.
- **Business Administration/Management.** Individuals plan, organize, direct, and control the functions and processes of a firm or organization. Individuals are expected to apply management theory, human resources management and behavior, accounting and other quantitative methods, purchasing and logistics, organization and production, marketing, and business decision-making.
- **Entrepreneurship/Entrepreneurial Studies**. Individuals perform development, marketing and management functions associated with owning and operating a business.
- **Farm/Farm and Ranch Management**. Individuals manage farms, ranches, and similar enterprises. Individuals are expected to apply agricultural specialization as well as business management, accounting, taxation, capitalization, purchasing, government programs and regulations, operational planning and budgeting, contracts and negotiation, and estate planning.
- **Industrial Management**. Individuals focus on the application of engineering principles to the planning and operational management of industrial and manufacturing operations, and prepare individuals to plan and manage such operations. Individuals are expected to apply accounting, engineering economy, financial management, industrial and human resources management, industrial psychology, management information systems, mathematical modeling and optimization, quality control, operations research, safety and health issues, and environmental program management. (New)

- **Operations Management and Supervision**. Individuals manage and direct the physical and/or technical functions of a firm or organization, particularly those relating to development, production, and manufacturing. Individuals are expected to apply principles of general management, manufacturing and production systems, plant management, equipment maintenance management, production control, industrial labor relations and skilled trade's supervision, strategic manufacturing policy, systems analysis, productivity analysis and cost control, and materials planning.
- **Small Business Administration/Management.** Individuals develop and manage independent small businesses. Individuals are expected to apply business administration; enterprise planning and entrepreneurship; start-up; small business operations and problems; personnel supervision; capitalization and investment; taxation; business law and regulations; e-commerce; home business operations; and applications to specific sectors, products, and services.

- **AGRONOMY**
  - **Agricultural Business and Management Career Field**
    - Agricultural Business Accountant
    - Agricultural Business Manager
    - Agricultural Commodity Broker
    - Agricultural Economist
    - Agricultural Land Appraiser/Sales
    - Agricultural Loan Officer
    - Central Test Station Manager
    - Chemical Applicator
    - Chemical, Fertilizer Plant Manager/Supervisor
    - Chemical, Fertilizer Plant Operator
    - Chemical, Fertilizer, Supply Distribution Manager
    - Chemical, Fertilizer, Supply Sales and Service Representative
    - Chemical, Fertilizer, Supply Sales and Service Worker
    - Crop Machinery and Equipment Sales Representative
    - Elevator Branch Manager/Grain Originator
    - Export Terminal Production Inspector
    - Farm Investment Manager
    - Feed Mill Operator
    - Feed Mill Supervisor/Manager
    - Field Representative for Bank, Insurance Company or Government Programs
    - Grain Accountant
    - Grain Elevator Operator
    - Grain Mill Product Inspector
    - Grain Operations Superintendent/Manager
    - Grain/Commodity Merchandiser/Buyer/Broker
    - Land Bank/Farm Credit Service Manager
    - Manager Information Systems Specialist (MIS)
    - Producer Buyer/Distributor
    - Resource Economist
    - Seed Department Manager
    - State Conservation Economist

- Technology Systems Manager
- Tobacco Buyer

❖ **Agricultural Operations Career Field**

- Agricultural Extension Specialist
- Certified Crop Advisor Research
- Field Inspector/Crop Scout
- Forage Producer/Business Operator
- Fruit Grower/Business Operator
- Geographic Information Systems (GIS) Coordinator
- Geographic Information Systems (GIS) Manager
- Geographic Information Systems (GIS) Specialist
- GPS Coordinator
- Grading and Packing Supervisor/Manager
- Grain Producer/Business Operator
- Production Farm Assistant/worker
- Seed Department Manager
- Specialty Crop Grower
- Storage Supervisor/Manager
- Vegetable Grower/Business Operator

❖ **Plant Sciences Career Field**

- Agricultural Extension Specialist
- Agronomist/Technician Service Agronomist
- Biosystems Engineer - Controlled Environments
- Crop Biochemist
- Crop Breeder
- Crop Physiologist
- Crop Scientist
- Greenhouse Operations Manager (Biosystems Manager)
- Hydroponics Specialist
- Pest Control Technician
- Plant Breeder
- Plant Diagnostician
- Plant Nutritionist
- Plant Scientist
- Weed Scientist

❖ **Zoology/Animal Biology Career Field**

- Biotechnologist
- Entomologist
- Marine Biologist
- Plant Biochemist

❖ **Physiology, Pathology and Related Sciences Career Field**

- Crop Scout
- Plant and Soil Microbiologist
- Plant Pathologist
- Range Conservationist
- Range Land Scientist
- Range Management Specialist
- Range Manager
- Range Soil Scientist/Special

- **Soil Sciences Career Field**
  - Agronomy Sales Representative
  - Manure/nutrient Management Specialist
  - Soil & Water Conservationist
  - Soil Biochemist
  - Soil Chemist
  - Soil Classification Specialist
  - Soil Fertility Specialist
  - Soil Management Specialist
  - Soil Physicist
  - Soil Scientist
- **Genetics Career Field**
  - Crop Geneticist
  - Plant Breeder
  - Plant Geneticist

AGRONOMY

- **Agricultural Production Operations Career Field**
  - **Agricultural Production Operations, General**. Individuals focus on the general planning, economics, and use of facilities, natural resources, equipment, labor, and capital to produce plant and animal products, and that may prepare individuals for work in farming, ranching, and agribusiness.
  - **Crop Production**. Individuals cultivate grain, fiber, forage. oilseed, fruits and nuts, vegetables, and other domesticated plant products. Individuals are expected to apply basic principles of plant science, health, and nutrition as applied to particular species and breeds; soil preparation and irrigation; pest management; planting and harvesting operations; product marketing; and applicable issues of safety, regulation, logistics, and supply.
- **Plant Sciences Career Field**
  - **Agricultural and Horticultural Plant Breeding.** Individuals focus on the application of genetics and genetic engineering to the improvement of agricultural plant health, the development of new plant varieties, and the selective improvement of agricultural plant populations. Individuals are expected to apply genetics, genetic engineering, population genetics, agronomy, plant protection, and biotechnology.
  - **Agronomy and Crop Science**. Individuals focus on the chemical, physical, and biological relationships of crops and the soils nurturing them. Individuals are expected to apply growth and behavior of agricultural crops, the development of new plant varieties, and the scientific management of soils and nutrients for maximum plant nutrition, health, and productivity.
  - **Bioinformatics.** Individuals focus on the application of computer-based technologies and services to biological, biomedical, and biotechnology research. Individuals are expected to apply algorithms, network architecture, principles of software design, human interface design, usability studies, search strategies, database management and data mining, digital image processing, computer graphics and animation, CAD, computer programming, and applications to experimental design and analysis and to specific quantitative, modeling, and analytical studies in the various biological specializations.
  - **Biotechnology.** Individuals focus on the application of the biological sciences, biochemistry, and genetics to the preparation of new and enhanced agricultural,

environmental, clinical, and industrial products, including the commercial exploitation of microbes, plants, and animals. Individuals are expected to apply bioinformatics, gene identification, phylogenetics and comparative genomics, bioinorganic chemistry, immunoassaying, DNA sequencing, xenotransplantation, genetic engineering, industrial microbiology, drug and biologic development, enzyme-based production processes, patent law, biotechnology management and marketing, applicable regulations, and biotechnology ethics.

- **Plant Protection and Integrated Pest Management**. Individuals focus on the application of scientific principles to the control of animal and weed infestation of domesticated plant populations, including agricultural crops; the prevention/reduction of attendant economic loss; and the control of environmental pollution and degradation related to pest infestation and pest control measures. Individuals are expected to apply entomology, applicable animal sciences, plant pathology and physiology, weed science, crop science, and environmental toxicology.
- **Plant Sciences, General**. Individuals focus on the scientific principles that underlie the breeding, cultivation, and production of agricultural plants, and the production, processing, and distribution of agricultural plant products. Individuals are expected to apply plant sciences, crop cultivation and production, and agricultural and food products processing.

❖ **Zoology/Animal Biology Career Field**

- **Entomology**. Individuals focus on the scientific study of insect species and populations in respect of their life cycles, morphology, genetics, physiology, ecology, taxonomy, population dynamics, and environmental and economic impacts. Individuals are expected to apply biological and physical sciences as well as insect toxicology and the biochemical control of insect populations.

❖ **Physiology, Pathology and Related Sciences Career Field**

- **Pathology/Experimental Pathology**. Individuals focus on the scientific study of the expression, initiation, maintenance and progression of tissue injury and disease, including death, and the relationship of pathogenesis to fundamental molecular and cellular mechanisms. Individuals are expected to apply immunology, microbiology, gene expression, inflammation, cell injury, apoptosis, immunopathology, molecular markers of disease and toxins, neoplasia, growth regulation, and organ-and system-specific investigations.
- **Range Science and Management**. Individuals focus on the scientific study of rangelands, arid regions, grasslands, and other areas of low productivity, as well as the principles of managing such resources for maximum benefit and environmental balance. Individuals are expected to apply livestock management, wildlife biology, plant sciences, ecology, soil science, and hydrology.

❖ **Soil Science Career Field**

- **Soil Chemistry and Physics**. Individuals focus on the application of chemical and physical principles to research and analysis concerning the nature and properties of soils and the conservation and management of soils. Individuals are expected to apply soil and fluid mechanics, mineralogy, sedimentology, thermodynamics, geomorphology, environmental systems, analytical methods, and organic and inorganic chemistry.
- **Soil Microbiology**. Individuals focus on application of microbiological theory and methods to the study of the organismic properties of soils, soil-plant and soil-animal interactions, and the biological components and effects of soil management

strategies. Individuals are expected to apply microbiology and related biological sciences, applicable animal and plant sciences, soil chemistry and physics as related to biological characteristics, and environmental science.

- **Soil Science and Agronomy, General**. Individuals focus on the scientific classification of soils, soil properties, and their relationship to agricultural crops. Individuals are expected to apply soil chemistry, soil physics, soil biology, soil fertility, morphogenesis, mineralogy, hydrology, agronomy, and soil conservation and management.

- **Genetics Career Field**
  - **Plant Genetics.** Individuals focus on the scientific study of the genetics of multicellular plants and fungi as related to botanical research as well as to applications in comparative genetics, ecology and evolutionary studies, clinical studies and industrial research. Individuals are expected to apply molecular genetics, gene expression, gene regulation, genomics, epigenetic phenomena, DNA recombination and repair, genetic interactions at the microbial and higher levels, and molecular evolution.
- **Agricultural Business and Management Career Field**
  - **Agribusiness/Agricultural Business Operations**. Individuals manage agricultural businesses and agriculturally related operations within diversified corporations. Individuals are expected to apply agriculture, appropriate agricultural specialization, business management, accounting, finance, marketing, planning, human resources management, and other managerial responsibilities.
  - **Agricultural Business and Management, General**. Individuals focus on modern business and economic principles involved in the organization, operation, and management of agricultural enterprises.
  - **Agricultural Business Technology**. Individuals perform specialized support functions related to agricultural business offices and operations and to operate agricultural office equipment, software, and information systems. Individuals are expected to apply basic agricultural business principles, office management, equipment operation, standard software, and database management.
  - **Agricultural Economics.** Individuals focus on the application of economics to the analysis of resource allocation, productivity, investment, and trends in the agricultural sector, both domestically and internationally. Individuals are expected to apply economics and related subfields as well as applicable agricultural fields.
  - **Agricultural/Farm Supplies Retailing and Wholesaling**. Individuals sell agricultural products and supplies, provide support services to agricultural enterprises, and purchase and market agricultural products. Individuals are expected to apply basic business management, marketing, retailing and wholesaling operations, and applicable principles of agriculture and agricultural operations.
  - **Applied Economics**. Individuals focus on the application of economic principles and analytical techniques to the study of particular industries, activities, or the exploitation of particular resources. Individuals are expected to apply economic theory; microeconomic analysis and modeling of specific industries, commodities; the economic consequences of resource allocation decisions; regulatory and consumer factors; and the technical aspects of specific subjects as they relate to economic analysis.
  - **Business Administration/Management.** Individuals plan, organize, direct, and control the functions and processes of a firm or organization. Individuals are expected to apply management theory, human resources management and behavior,

accounting and other quantitative methods, purchasing and logistics, organization and production, marketing, and business decision-making.

- **Entrepreneurship/Entrepreneurial Studies**. Individuals perform development, marketing and management functions associated with owning and operating a business.
- **Farm/Farm and Ranch Management**. Individuals manage farms, ranches, and similar enterprises. Individuals are expected to apply agricultural specialization as well as business management, accounting, taxation, capitalization, purchasing, government programs and regulations, operational planning and budgeting, contracts and negotiation, and estate planning.
- **Industrial Management**. Individuals focus on the application of engineering principles to the planning and operational management of industrial and manufacturing operations, and prepare individuals to plan and manage such operations. Individuals are expected to apply accounting, engineering economy, financial management, industrial and human resources management, industrial psychology, management information systems, mathematical modeling and optimization, quality control, operations research, safety and health issues, and environmental program management. (New)
- **Operations Management and Supervision**. Individuals manage and direct the physical and/or technical functions of a firm or organization, particularly those relating to development, production, and manufacturing. Individuals are expected to apply principles of general management, manufacturing and production systems, plant management, equipment maintenance management, production control, industrial labor relations and skilled trade's supervision, strategic manufacturing policy, systems analysis, productivity analysis and cost control, and materials planning.
- **Small Business Administration/Management.** Individuals develop and manage independent small businesses. Individuals are expected to apply business administration; enterprise planning and entrepreneurship; start-up; small business operations and problems; personnel supervision; capitalization and investment; taxation; business law and regulations; e-commerce; home business operations; and applications to specific sectors, products, and services.

♦ AGRICULTURAL PUBLIC SERVICES

❖ Agricultural Public Services Career Field

- 4-H Extension Agent
- Ag Communication Specialist Grant Writer
- Agricultural Extension Administrator
- Agricultural Extension Agent
- Agricultural Extension Specialist
- Agricultural Journalist
- Agricultural Law Specialist
- Agricultural News Director
- Agricultural Radio/TV Broadcaster
- Agriculture Education Teacher - High School
- Association Office Manager/Director/Executive Secretary
- Beef Association Executive Secretary
- College Faculty Member
- Conservation or Environmental Education Specialist

- Editor
- Extension Specialist
- Extension Program Assistants
- Farm Broadcaster
- Lobbyist
- Public Relations Specialist

❖ **International Agriculture Career Field**

- Foreign Agricultural Service Consultant (FAS)
- International Specialist

♦ **AGRICULTURAL PUBLIC SERVICES**

❖ **Agricultural Public Services Career Field**

➢ **Agricultural and Extension Education Services.** Individuals provide referral, consulting, technical assistance, and educational services to gardeners, farmers, ranchers, agribusinesses, and other organizations. Individuals are expected to apply basic agricultural sciences, agricultural business operations, pest control, adult education methods, public relations, applicable state laws and regulations, and communications skills.

➢ **Agricultural Communications/Journalism.** Individuals apply journalistic, communications, and broadcasting principles to the development, production, and transmittal of agricultural information. Individuals are expected to apply basic journalism, broadcasting, film/video, and communications techniques; the production of technically specialized information products for agricultural audiences; and the principles of agricultural sciences and business operations needed to develop and communicate agricultural subject matter in effective ways.

➢ **Agricultural Teacher Education.** Individuals teach vocational agricultural programs at various educational levels.

❖ **Agricultural Public Relations Career Field**

➢ **Broadcast Journalism.** Individuals focus on the methods and techniques for reporting, producing, and delivering news and news programs via radio, television, and video/film media; and that prepares individuals to be professional broadcast journalists, editors, producers, directors, and managers. Individuals are expected to apply principles of broadcast technology; broadcast reporting; on- and off-camera and microphone procedures and techniques; program, sound, and video/film editing; program design and production; media law and policy; and professional standards and ethics.

➢ **Journalism.** Individuals focus on the theory and practice of gathering, processing, and delivering news and that prepares individuals to be professional print journalists, news editors, and news managers. Individuals are expected to apply news writing and editing; reporting; photojournalism; layout and graphic design; journalism law and policy; professional standards and ethics; research methods; and journalism history and criticism.

♦ **MISCELLANEOUS**

❖ **Ecology, Evolution, Systematics, and Population Biology Career Field**

➢ **Ecology.** Individuals focus on the scientific study of the relationships and interactions of small-scale biological systems, such as organisms, to each other, to complex and whole systems, and to the physical and other non-biological aspects of their environments. Individuals are expected to apply biogeochemistry; landscape

and/or marine/aquatic dynamics; decomposition; global and regional elemental budgets; biotic and abiotic regulation of nutrient cycles; ecophysiology; ecosystem resilience, disturbance, and succession; community and habitat dynamics; organismal interactions (co-evolution, competition, predation); paleoecology, and evolutionary ecology.

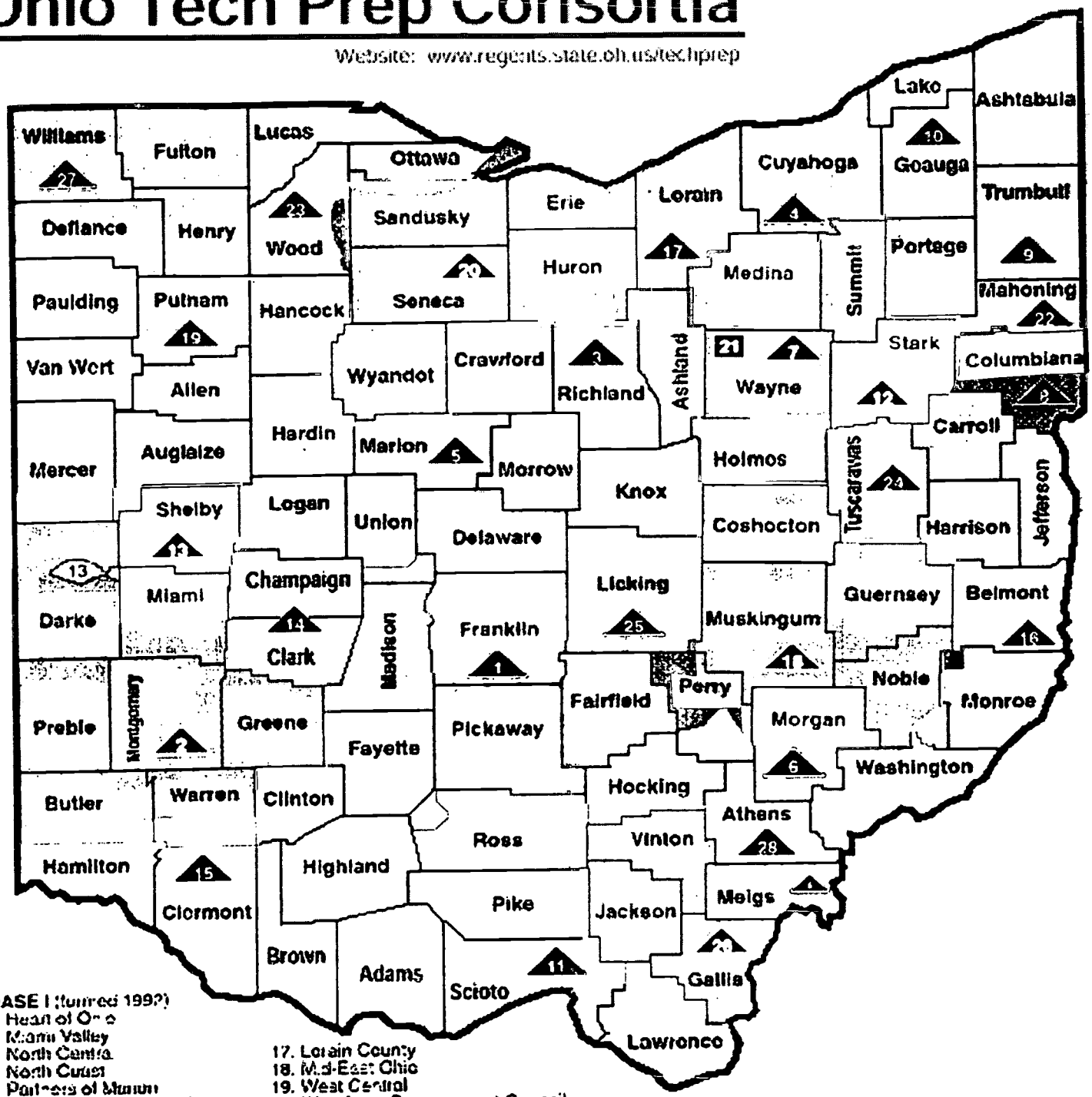
- **Physiology, Pathology and Related Sciences Career Field**
  - **Cell Physiology.** Individuals focus on the scientific study of physiological processes operating within and among cells, and intracellular communication and behavior, in the context of larger systems and whole organisms. Individuals are expected to apply cell and molecular biology, molecular physiology, cell cycle control, signal transduction, protein structure, membrane biochemistry and structure, ion channel physics, cell respiration and digestion, secretory functions, cell adhesion and communication, information encoding and decoding, and the relation of cell physiology to tissue, organ, and organismic functioning.
  - **Molecular Physiology.** Individuals focus on the scientific study of dynamic interactive processes and biochemical communications at the subcellular level. Individuals are expected to apply ion channels and transporters, molecular signaling pathways, endocrine control and regulation, genetic information transfer, homeostasis and molecular control systems, electrophysiology and sensory mechanisms, protein synthesis, and applicable research methods and technologies.
  - **Physiology, General.** Individuals focus on the scientific study of the functional dynamics, morphology, and biochemical and biophysical communications within organisms and between living systems at all levels of complexity and integration. Individuals are expected to apply reproduction, growth, hormonal action, vascular function, respiration, digestion, sensory perception and processing, sensorimotor integration, signal encoding and conveyance, homeostasis, physical function and malfunction, evolutionary physiology, and disease processes.
- **International Agriculture Career Field**
  - **International Agriculture.** Individuals focus on the application of agricultural management and scientific principles to the problems of global food production and distribution and to the study of the agricultural systems of other countries. Individuals are expected to apply agricultural economics; comparative agricultural systems; international agribusiness and law; third-world development studies and economic development; and global applications of climate, soil, water resources, ecological and environmental studies, and animal and plant sciences.

Appendix E

Ohio Tech Prep Consortia

Ohio Tech Prep Consortia

Website: www.regents.state.oh.us/techprep



PHASE I (formed 1992)
1. Heart of Ohio
2. Miami Valley
3. North Central
4. North Coast
5. Partners of Marion
6. Washington-Morgan-Meigs

PHASE II (formed 1993)
7. Akron Area
8. Columbiana County
9. Kent
10. Lake Area
11. Ohio South
12. Stark County
13. Upper Miami Valley

PHASE III (formed 1994)
14. Clark State
15. Greater Cincinnati
16. Eastern Ohio Valley
17. Lorain County
18. Mid-East Ohio
19. West Central
20. Workforce Development Council

PHASE IV (formed 1995)
21. Ohio State - Agricultural Technical Institute (with programs at locations throughout Ohio)
22. Mahoning Area
23. Northwest Ohio
24. Tuscarawas Valley

PHASE V (formed 1996)
25. East Central Ohio
26. Ohio Valley
27. Maumee Valley
28. Southeast

10/29/98

Note: Consortia 8, 9 and 24 merged with headquarters at 09

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Office of Educational Research and Improvement (OERI)
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