Maryland
STATE DEPARTMENT OF EDUCATION

# Program of Study Guide: Agriculture Science - Draft

Comprehensive guidelines and course standards for the Agriculture Science pathway

Office of College and Career Readiness

July 2025

## MARYLAND STATE DEPARTMENT OF EDUCATION

**Carey M. Wright, Ed.D.**
State Superintendent of Schools

**Tenette Smith, Ed.D.**
Deputy State Superintendent
Office of Teaching and Leading

**Richard Kincaid**
Assistant State Superintendent
Division of College and Career Pathways

**Wes Moore**
Governor

## MARYLAND STATE BOARD OF EDUCATION

**Joshua L. Michael, Ph.D.**
President, Maryland State Board of Education

Monica Goldson, Ed.D. (Vice President)

Chuen-Chin Bianca Chang, MSN, PNP, RN-BC

Kenny Clash

Clarence C. Crawford (President Emeritus)

Abhiram Gaddam (Student Member)

Susan J. Getty, Ed.D.

Nick Greer

Dr. Irma E. Johnson

Kim Lewis, Ed.D.

Dr. Joan Mele-McCarthy, D.A., CCC-SLP

Rachel L. McCusker

Xiomara V. Medina, M.Ed.

Samir Paul, Esq.

# Table of Contents

# Document Control Information

| | |
|---|---|
| **Title:** | Agriculture Science Program Guide |
| **Security Level:** | Unclassified – For Official Use Only |
| **File Name:** | Agriculture Science Guide |

## DOCUMENT HISTORY

| Document Version | Date | Summary of Change |
|---|---|---|
| 1.0 | December 2024 | Initial Document |

# Purpose

**The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Agriculture Science Program of Study. The academic standards in this document are theoretical and performance based. The standards contain content from multiple state departments of education, the College Board, and the National Council for Agriculture Education and have been reviewed and vetted by members of the Maryland business and industry community.**

In addition to academic standards, the Maryland State Department of Education (MSDE) has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and Work-Based Learning resources and requirements by course level. This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.

# Standards Sources

These sources collectively guide the standards for Agriculture Science I-III Course Standards, ensuring alignment with national education frameworks and industry-recognized certifications essential for developing a skilled agricultural science workforce.

Below are key sources that inform and shape the Agriculture Science standards, presented in the requested format with a brief description, suggested usage, and a direct link or citation for each.

1. **Advance CTE – Agriculture Career Cluster**
   A. Description: Advance CTE (formerly NASDCTEc) provides national Career Cluster® frameworks, including the Agriculture Career Cluster, which emphasizes the scientific advancement of agriscience, sustainable practices, and a systems approach to cultivating, processing, and distributing agricultural products.
   B. Usage: These frameworks guide the development of high school Agriculture Science course standards, ensuring alignment with nationally recognized competencies in agriscience, stewardship, and workforce readiness.
   C. Source: Advance CTE – Agriculture Career Cluster

2. **National Agriculture, Food, and Natural Resources (AFNR) Standards**
   A. Description: Developed by The National Council for Agricultural Education, the AFNR Standards provide rigorous learning expectations spanning plant and animal systems, natural resources, food products, and more.
   B. Usage: Educators integrate AFNR Standards into curricula and lesson planning, ensuring students gain industry-relevant knowledge and skills in agricultural production, sustainability, and technology.
   C. Source: National Council for Agricultural Education – AFNR Standards

3. **Occupational Safety and Health Administration (OSHA)**
   A. Description: OSHA sets and enforces standards to ensure safe and healthful working conditions across industries, including agriculture (e.g., OSHA 30 training).
   B. Usage: In high school Agriculture Science courses, OSHA guidelines inform safety protocols, equipment handling practices, and hazard identification, culminating in the potential for an OSHA 30 credential by Course II.
   C. Source: OSHA – Occupational Safety and Health Administration

4. **Federal Aviation Administration (FAA) – Part 107**
   A. Description: The FAA regulates all aspects of civil aviation in the United States. Part 107 specifically governs the commercial use of small unmanned aircraft systems (UAS), including drones.
   B. Usage: Agriculture Science courses covering drone technology align lessons and labs with Part 107 to prepare students for safe UAS operation and the FAA Remote Pilot Certificate exam (often in Courses III or IV).
   C. Source: FAA – Part 107 sUAS Regulations

5. **Esri Technical Certification**

   A. Description: Esri is a leading provider of GIS (Geographic Information System) software, offering certifications (e.g., ArcGIS Desktop Associate) that validate geospatial analysis and mapping proficiency.
   B. Usage: High school Agriculture Science courses integrate GIS concepts—such as data collection, spatial analysis, and precision agriculture—laying the groundwork for students to pursue Esri's industry-recognized certifications in advanced courses.
   C. Source: Esri – Technical Certification

6. **U.S. Department of Agriculture (USDA)**

   A. Description: The USDA is a federal agency that oversees various agricultural, forestry, and food-related programs across the United States. Through research, policy, and extension services, the USDA supports sustainable farming, conservation practices, rural development, and food security.
   B. Usage: High school Agriculture Science curricula often reference USDA materials and guidelines, particularly for up-to-date research on conservation programs, wildlife-friendly farming, and resource management. Students gain insight into best practices and national initiatives that shape agricultural production and stewardship.
   C. Source: U.S. Department of Agriculture (USDA)

7. **U.S. Fish and Wildlife Service (USFWS)**

   A. Description: The USFWS is the federal agency dedicated to the management and conservation of fish, wildlife, and natural habitats. It enforces federal wildlife laws, protects endangered species, restores nationally significant fisheries, and conserves and restores wildlife habitat.
   B. Usage: Agricultural education programs integrate USFWS resources to explore responsible wildlife management, habitat conservation, and the balance between agricultural land use and biodiversity. Lessons on protecting migratory birds or wetlands, for example, connect students to real-world scenarios in eco-conscious farming.
   C. Source: U.S. Fish and Wildlife Service

8. **National Park Service (NPS)**

   A. Description: The NPS manages and preserves national parks, monuments, and historical sites across the United States, offering recreational opportunities while safeguarding natural and cultural resources. It conducts scientific research and implements policies for habitat preservation, wildlife management, and visitor education.
   B. Usage: When high school Agriculture Science coursework includes elements of parkland management, wildlife habitat protection, or ecosystem restoration, educators often reference NPS best practices and case studies. Projects may involve data collection in local parks, comparisons of land management strategies, or exploration of career pathways in conservation and recreation.
   C. Source: National Park Service (NPS)

# Course Descriptions

| Course Level | Course Information | Description |
|---|---|---|
| Required Core: Course 1 | Agriculture Science I<br>SCED: <XX><br>Grades: 9-12<br>Prerequisite: None<br>Credit: 1 | This introductory course lays the foundation of agriscience, emphasizing basic plant and animal science, personal and environmental safety, and an overview of agribusiness industries. Fundamental OSHA concepts are introduced, paving the way for OSHA 30 certification in the subsequent course. |
| Required Core: Course 2 | Agriculture Science II<br>SCED: <XX><br>Grades: 10-12<br>Prerequisite: Agriculture Science I<br>Credit: 1 | Expanding upon the basics covered in Agriculture Science I, Agriculture Science II delves into advanced safety procedures, enabling students to pursue OSHA 30 certification by the end of the course. |
| Optional Flex: Course 1 | Agriculture Science III<br>SCED: <XX><br>Grades: 11-12<br>Prerequisite: Agriculture Science I & II<br>Credit: 1 | This capstone course refines students' proficiency in GIS and UAS (drone) technology, culminating in mastery of ArcGIS Desktop capabilities and FAA Part 107 operational standards. Learners undertake in-depth research or capstone projects, analyzing high-level data and proposing innovative solutions that support regenerative agriculture, community resilience, and stewardship—with a special focus on land and wildlife management. |

| Course Level | Course Information | Description |
|---|---|---|
| Optional Flex: Course 2 | Career Connected Learning I<br>SCED: <XX><br>Grades: 11-12<br>Prerequisite: Agriculture Science I and II<br>Credit: 1 | This flexible, work-based learning course introduces students to real-world applications of classroom knowledge and technical skills through on-the-job experiences and reflective practice. Students engage in career exploration, skill development, and professional networking by participating in youth apprenticeships, registered apprenticeships, pre-apprenticeships, internships, capstone projects, or other approved career-connected opportunities. Variable credit (1–3) accommodates the required on-the-job training hours and related instruction. By integrating industry standards, employability skills, and personalized learning goals, Career Connected Learning I equips students to make informed career decisions, develop a professional portfolio, and build a strong foundation for success in postsecondary education, training, or the workforce. |
| Optional Flex: Course 3 | Career Connected Learning II<br>SCED: <XX><br>Grades: 11-12<br>Prerequisite: Career Connected Learning I<br>Credit: 1 | Building on the foundational experiences of Career Connected Learning I, this advanced work-based learning course provides students with deeper on-the-job practice, leadership opportunities, and refined career exploration. Students continue to enhance their technical and professional skills, expanding their industry networks and aligning personal goals with evolving career interests. Variable credit (1–3) remains aligned with the required training hours and related instruction. Through elevated responsibilities and skill application, Career Connected Learning II prepares students to confidently transition into higher-level postsecondary programs, apprenticeships, or the workforce. |

***Dual Enrollment and Career Connected Learning Experiences Must be Aligned to the CTE Core.***

# Industry-Recognized Credentials and Work-Based Learning

| **Industry-Recognized Credentials: – The standards in this document are aligned to the following certifications:** |
|---|
| **By the end of Agriculture Science I:** OSHA 10 (Not on the IRC List).<br><br>**By the end of Agriculture Science II:** OSHA 30<br><br>**By the end of Agriculture Science III:** ESRI Technical Certification – ArcGIS Desktop Associate |

| **Work-based Learning Resources** | | |
|---|---|---|
| **Agriculture Science I: Career Awareness** | **Agriculture Science II: Career Preparation** | **Flex Courses: Career Preparation** |
| • Industry Visits<br>• Guest Speakers<br>• Participation in Career and Technical Student Organizations<br>• Postsecondary Visits – Program Specific Site Tours<br>• Mock Interviews | • All of Career Awareness plus the following:<br>• Job Shadow<br>• Paid and Unpaid Internships | • Paid and Unpaid Internships<br>• Apprenticeships |

# Labor Market Information: Definitions and Data

Labor market information (LMI) plays a crucial role in shaping Career and Technical Education (CTE) programs by providing insights into industry demands, employment trends, and skills gaps. This data helps education leaders assess the viability of existing programs and identify opportunities for new offerings. By aligning CTE programs with real-time labor market needs, schools can better prepare students for in-demand careers and ensure that resources are effectively utilized to support pathways that lead to high-quality, sustainable employment.

**Standard Occupational Code (SOC) and Aligned Industry:**

| Indicator | Definition | Pathway Labor Market Data |
|---|---|---|
| **High Wage**[1] | Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the state of Maryland, and/or leads to a position that pays at least the median hourly or annual wage for the DC-VA-MD-WV Metropolitan Statistical Area (MSA).<br><br>*Note: A 25th percentile hourly wage of $24.74 or greater is required to meet this definition.* | **Standard Occupational Code: Aerospace Engineering:**<br>19-1011 – Animal Scientists<br>19-1013 – Soil and Plant Scientists<br><br>**Hourly Wage/Annual Salary:** |
| **High Skill** | Those occupations located within the DC-VA-MD-WV Metropolitan Statistical Area (MSA) with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, bachelor's degree, or higher. | **Typical Entry-Level Education:** |
| **In-Demand** | Annual growth plus replacement, across all Maryland occupations, is 405 openings between 2024-2029. | **Annual Openings:** |

[1] Living Wage Calculator: https://livingwage.mit.edu/states/24

**Labor Market Information Data Source**

Lightcast Q4 2024 Data Set. Lightcast occupation employment data are based on final Lightcast industry data and final Lightcast staffing patterns. Wage estimates are based on Occupational Employment Statistics (QCEW and Non-QCEW Employees classes of worker) and the American Community Survey (Self-Employed and Extended Proprietors). Occupational wage estimates are also affected by county-level Lightcast earnings by industry. Foundational data for the state of Maryland is collected and reported by the Maryland Department of Labor.

**Methodology for High Wage Calculations**

To combine labor market data across multiple Standard Occupational Classifications (SOCs), a weighted average approach was used to ensure accurate representation of the marketplace. Median wages for each SOC were weighted based on their respective employment levels, reflecting the relative demand for each occupation. This method ensures that occupations with higher employment contribute proportionately to the overall wage calculation. Additionally, job openings from all relevant SOCs were summed to determine the total projected demand. For example, if Mechanical Engineers account for 67% of total employment and Electrical Engineers for 33%, their respective wages are weighted accordingly, and job openings are aggregated to provide a comprehensive view of labor market opportunities. This approach delivers a balanced and accurate representation of both wages and employment demand for the program.

**Methodology for In-Demand Calculations**

The baseline for annual job openings, taking into account new positions and replacement positions, was determined by taking the average of all annual job openings between 2024 and 2029 across all 797 career sectors at the 5-digit SOC code level. For the 2024-2029 period, average job openings (growth + replacement) is 405.

# Course Standards: Agriculture Science I

1. **General requirements.** This course is recommended for students in Grades 9-12, and there are no prerequisites.

2. **Introduction.**
   A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

   B. The Agriculture Career Cluster concentrates on scientific advancement of agriscience, cultivation, processing, and distribution of agricultural products, employing advanced technologies and sustainable practices to optimize global food systems. This Cluster also supports other plant- and animal-based industries including regenerative agriculture, sustainable logging, and fisheries. This Cluster has meaningful connections with the Energy and Natural Resources Cluster, highlighting a symbiotic relationship that emphasizes stewardship and resilient communities.

   C. The Agriculture Science Career and Technical Education Program of Study equips students with progressive agriscience knowledge, emphasizing safe practices, scientific inquiry, sustainable resource management, and land and wildlife management. This comprehensive approach aligns with the Advance CTE Agriculture Career Cluster, fostering stewardship, resilient communities, and pathways for success in modern agriculture—while also recognizing the importance of protecting natural landscapes, safeguarding forests and waterways, and balancing conservation efforts with recreational use of public lands.

   D. In Agriculture Science I, students learn essential skills in scientific inquiry, environmental stewardship, and fundamental land and wildlife management principles—examining how sustainable practices in farming and natural resource conservation protect habitats. Throughout the course, students explore the interdependence of agriculture and ecosystems, including public lands, rangelands, and forests.

   E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.

   F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. **Knowledge and Skills.**
   A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
      1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
      2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
      3. Employ effective reading, writing, and technical documentation skills.

4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of equipment and following engineering guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the agriculture science field, following intellectual property laws and best practices for agriculture science.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. **The student identifies various career pathways in the agriculture science field. The student is expected to:**
   1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in engineering design.
   2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
   3. Demonstrate effective interview skills for roles in agriculture science.

C. **The student develops technology and digital literacy skills. The student is expected to:**
   1. Apply secure file management practices (e.g., consistent naming conventions, folder structures, backups) for handling digital documents, GIS datasets, and drone imagery.
   2. Evaluate the credibility and reliability of online resources (e.g., scientific journals, regulatory websites) to inform data-driven decisions and validate research in agriscience.
   3. Demonstrate safe and ethical use of digital platforms, including compliance with data privacy guidelines, software licensing, and responsible sharing of geospatial or aerial imagery.
   4. Collaborate using cloud-based tools (e.g., shared drives, project management apps) to coordinate tasks, exchange data, and communicate with peers or industry partners effectively.
   5. Integrate software applications (e.g., spreadsheets, GIS programs, flight planning apps) to analyze and visualize data, supporting precision agriculture, safety compliance, and decision-making.

D. **The student integrates core academic skills into agriculture science practices. The student is expected to:**
   1. Apply algebraic or statistical methods (e.g., mean, median, regression analysis) to interpret crop yield data, livestock growth records, or safety inspection results.
   2. Compose clear and concise technical documents (e.g., research reports, standard operating procedures) that integrate proper grammar and domain-specific vocabulary.
   3. Analyze scientific texts (e.g., peer-reviewed journals, regulatory guidelines) to extract key ideas, assess credibility, and draw evidence-based conclusions for agricultural decision-making.
   4. Demonstrate scientific reasoning skills (e.g., hypothesis formulation, controlled experimentation) to investigate and solve real-world challenges in food production, environmental stewardship, or technology integration.

E. **The student demonstrates foundational knowledge of the Agriculture Career Cluster, including career pathways, industry scope, and the role of scientific advancement. The student is expected to:**
   1. Identify the scope of the Agriculture Career Cluster, including plant- and animal-based industries, to understand the diversity of career opportunities in agriculture, including regenerative farming, sustainable logging, fisheries, and careers in land and wildlife management (e.g., park rangers, conservation officers).

diversity of career opportunities including farming, production of crops, livestock; food industry and systems careers including food science specialists, ; value-added foods; on-farm careers in agritourism, direct- to-consumer marketing, industry positions in crop science, animal science, industry careers in breeding and genetics of animals and plants, animal health provider, crop protection specialist, conservation or nutrient management specialist; working in agriculture regulatory science, ag policy, etc.

2. Investigate emerging technologies (e.g., drones, GIS, automated equipment) in AFNR and describe how they optimize production, enhance efficiency, and contribute to scientific advancement, including applications for natural resource and habitat monitoring in local, state, and national parks.
3. Demonstrate effective communication (written and verbal) when describing foundational concepts in AFNR, reinforcing academic skills in English and STEM, and articulate how ecological conservation merges with recreational spaces to enhance community well-being.

F. **The student demonstrates an understanding of basic safety principles and compliance with introductory OSHA guidelines. The student is expected to:**
   1. Recognize the importance of fundamental safety protocols, including an introduction to OSHA standards, the use of personal protective equipment (PPE), and safe handling of tools and machinery in agricultural settings, with attention to potential hazards encountered when managing natural landscapes and wildlife (e.g., trail maintenance, controlled burns, or wildlife monitoring).

G. **The student demonstrates fundamental knowledge of plant and animal science concepts, including scientific inquiry methods. The student is expected to:**
   1. Examine essential plant and animal science concepts (e.g., growth requirements, life cycles, basic anatomy) to understand how scientific principles guide agricultural production and resource management, including strategies for conserving wildlife habitats and sustaining diverse ecosystems.
   2. Apply introductory scientific inquiry methods (e.g., formulating hypotheses, collecting data, drawing conclusions) to simple agriscience experiments or supervised agricultural experiences (SAEs), incorporating basic field observations relevant to land and wildlife management (e.g., tracking wildlife populations, assessing forest or rangeland health).

H. **The student demonstrates an understanding of sustainability, stewardship, and environmental responsibility within global food systems. The student is expected to:**
   1. Explain how sustainable practices and environmental stewardship (e.g., soil conservation, water management) support resilient communities and align with global food system needs, emphasizing the balance between ecological conservation and recreational use of public lands.
   2. Discuss ethical and sustainable resource management principles (e.g., regenerative agriculture, responsible logging, and fisheries conservation) that promote stewardship within local and global contexts, including maintenance of parks, forests, and rangelands to protect wildlife, preserve natural resources, and foster public accessibility.

# Course Standards: Agriculture Science II

1. **General requirements.** This course is recommended for students in Grades 10-12, and Agriculture Science I is the prerequisite.

2. **Introduction.**
   A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

   B. The Agriculture Career Cluster concentrates on scientific advancement of agriscience, cultivation, processing, and distribution of agricultural products, employing advanced technologies and sustainable practices to optimize global food systems. This Cluster also supports other plant- and animal-based industries including regenerative agriculture, sustainable logging, and fisheries. This Cluster has meaningful connections with the Energy and Natural Resources Cluster, highlighting a symbiotic relationship that emphasizes stewardship and resilient communities.

   C. The Agriculture Science Career and Technical Education Program of Study equips students with progressive agriscience knowledge, emphasizing safe practices, scientific inquiry, sustainable resource management, and land and wildlife management. This comprehensive approach aligns with the Advance CTE Agriculture Career Cluster, fostering stewardship, resilient communities, and pathways for success in modern agriculture—while also recognizing the importance of protecting natural landscapes, safeguarding forests and waterways, and balancing conservation efforts with recreational use of public lands.

   D. In Agriculture Science II, learners apply scientific principles to sustainable plant and animal production, analyze data-driven methods, and investigate land and wildlife management practices—such as habitat conservation, ethical harvesting, and recreational land use. Through project-based activities, students sharpen critical thinking, problem-solving, and community engagement skills, positioning them for leadership roles in agriscience and natural resource stewardship.

   E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.

   F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. Knowledge and Skills.
   A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
      1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
      2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
      3. Employ effective reading, writing, and technical documentation skills.

4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following cybersecurity guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the agriculture science field, following data privacy laws and best practices for security.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. **The student identifies various career pathways in the agriculture science field. The student is expected to:**
   1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in agriculture science.
   2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
   3. Demonstrate effective interview skills for roles in agriculture science.

C. **The student develops technology and digital literacy skills. The student is expected to:**
   1. Apply secure file management practices (e.g., consistent naming conventions, folder structures, backups) for handling digital documents, GIS datasets, and drone imagery.
   2. Evaluate the credibility and reliability of online resources (e.g., scientific journals, regulatory websites) to inform data-driven decisions and validate research in agriscience.
   3. Demonstrate safe and ethical use of digital platforms, including compliance with data privacy guidelines, software licensing, and responsible sharing of geospatial or aerial imagery.
   4. Collaborate using cloud-based tools (e.g., shared drives, project management apps) to coordinate tasks, exchange data, and communicate with peers or industry partners effectively.
   5. Integrate software applications (e.g., spreadsheets, GIS programs, flight planning apps) to analyze and visualize data, supporting precision agriculture, safety compliance, and decision-making.

D. **The student integrates core academic skills into networking practices. The student is expected to:**
   1. Apply algebraic or statistical methods (e.g., mean, median, regression analysis) to interpret crop yield data, livestock growth records, or safety inspection results.
   2. Compose clear and concise technical documents (e.g., research reports, standard operating procedures) that integrate proper grammar and domain-specific vocabulary.
   3. Analyze scientific texts (e.g., peer-reviewed journals, regulatory guidelines) to extract key ideas, assess credibility, and draw evidence-based conclusions for agricultural decision-making.
   4. Demonstrate scientific reasoning skills (e.g., hypothesis formulation, controlled experimentation) to investigate and solve real-world challenges in food production, environmental stewardship, or technology integration.

E. **The student demonstrates the necessary skills to expand workplace safety knowledge in preparation for OSHA 30 certification within agricultural contexts. The student is expected to:**
   1. Compare and contrast specific OSHA standards relevant to machinery, chemicals, and confined spaces in agriculture, building on introductory safety concepts from Agriculture Science I, including those applicable to managing trails, park facilities, and wildlife habitats.

2. Apply advanced hazard analysis techniques (e.g., Job Hazard Analysis) to identify, evaluate, and mitigate potential risks in on-farm settings, as well as in natural resource areas (e.g., forests, wetlands) where students may encounter uneven terrain, wildlife, or environmental hazards.
3. Demonstrate proper use of personal protective equipment (PPE) and adherence to lockout/tagout procedures when operating or servicing agricultural equipment, extending these safety protocols to activities such as controlled burns or habitat maintenance.
4. Develop an emergency response plan for agricultural operations, incorporating first aid, fire prevention, and environmental incident protocols, and include considerations for public land stewardship (e.g., park visitor emergencies, wildlife encounters).

F. **The student demonstrates the necessary skills to refine and apply scientific principles for sustainable plant and soil management. The student is expected to:**
   1. Analyze soil health indicators (e.g., pH, organic matter, nutrient content) and recommend management practices (e.g., cover cropping, reduced tillage) that enhance fertility and sustainability, emphasizing how these practices also support native habitats and minimize impact on local wildlife.
   2. Identify advanced integrated pest management (IPM) strategies, including cultural, biological, and chemical control methods, emphasizing responsible pesticide use, and evaluate how these methods can be adapted for public lands, forests, and rangelands.
   3. Examine how emerging agriscience technologies (e.g., sensors, precision irrigation) improve crop yields while minimizing resource consumption and environmental impact, and explore their applications in maintaining healthy landscapes, wildlife corridors, and recreation areas.
   4. Evaluate the impact of climate patterns on plant growth and adapt management practices to ensure resilience within local and global food systems, including strategies to protect vulnerable ecosystems (e.g., wetlands, parklands) from extreme weather events.

G. **The student demonstrates the necessary skills to employ advanced animal science techniques aligned with ethical and sustainable production practices. The student is expected to:**
   1. Compare methods of animal breeding, nutrition, and health management, incorporating data collection (e.g., growth rate, feed efficiency) to optimize production outcomes, and discuss parallels in wildlife management (e.g., maintaining healthy populations, minimizing disease spread).
   2. Explain how advancements in genetics, diagnostics, and technology (e.g., wearable health sensors) contribute to improved animal welfare and productivity, and consider how similar monitoring tools are used by conservation agencies to track wildlife.
   3. Implement protocols for humane handling, transportation, and processing of livestock, referencing industry guidelines (e.g., Beef Quality Assurance) to ensure ethical standards, drawing connections to the humane handling of wildlife in rescue, relocation, or research.
   4. Investigate ways to integrate regenerative practices (e.g., rotational grazing) that maintain soil quality, conserve water, and support overall ecosystem health, including habitat protection for native species and pollinators.

H. **The student demonstrates the necessary skills to integrate sustainable resource management and stewardship practices within agriscience systems. The student is expected to:**
   1. Assess energy usage on farms (e.g., machinery, irrigation), identifying opportunities for renewable energy adoption (solar, biomass) that align with the Energy and Natural Resources Cluster, and explore how parks, forests, or wildlife reserves can utilize these solutions.

2. Compare sustainable harvesting methods in plant- and animal-based industries (e.g., selective logging, fisheries management) that protect biodiversity and long-term resource availability, and extend these principles to maintaining public lands (e.g., preventing overharvesting of timber or overfishing in protected waters).
3. Investigate environmental monitoring tools (e.g., GIS data layers, remote sensing images) to evaluate soil erosion, water pollution, or habitat loss, connecting classroom learning to future ArcGIS applications, focusing on land management practices in state parks, national forests, and wildlife corridors.
4. Collaborate with community or industry partners on a small-scale project (e.g., stream buffer restoration, habitat improvement), demonstrating how stewardship and resilient communities are interlinked, especially in balancing ecological conservation with recreational use (e.g., trails, wildlife observation areas).

# Course Standards: Agriculture Science III

1. **General requirements.** This course is recommended for students in Grades 11-12, and Agriculture Science I and II are the prerequisites.

2. **Introduction.**
   A. Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

   B. The Agriculture Career Cluster concentrates on scientific advancement of agriscience, cultivation, processing, and distribution of agricultural products, employing advanced technologies and sustainable practices to optimize global food systems. This Cluster also supports other plant- and animal-based industries including regenerative agriculture, sustainable logging, and fisheries. This Cluster has meaningful connections with the Energy and Natural Resources Cluster, highlighting a symbiotic relationship that emphasizes stewardship and resilient communities.

   C. The Agriculture Science Career and Technical Education Program of Study equips students with progressive agriscience knowledge, emphasizing safe practices, scientific inquiry, sustainable resource management, and land and wildlife management. This comprehensive approach aligns with the Advance CTE Agriculture Career Cluster, fostering stewardship, resilient communities, and pathways for success in modern agriculture—while also recognizing the importance of protecting natural landscapes, safeguarding forests and waterways, and balancing conservation efforts with recreational use of public lands.

   D. In Agriculture Science III, students integrate advanced data analysis in precision agriculture, develop complex mapping skills, and practice drone flight planning and operation for real-world applications. Coursework also underscores regenerative practices, sustainable logging, fisheries, and the intersection of agriculture with the Energy and Natural Resources Cluster, now incorporating wildlife monitoring and public land management scenarios. By analyzing geospatial data related to forests, water systems, and conservation areas, students gain a holistic understanding of how agriscience can coexist with recreational and ecological interests.

   E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.

   F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. Knowledge and Skills.
   A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
      1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
      2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.

3. Employ effective reading, writing, and technical documentation skills.
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following cybersecurity guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the Agriculture science field, following data privacy laws and best practices for security.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. **The student identifies various career pathways in the agriculture science field. The student is expected to:**
   1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in Agriculture science.
   2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
   3. Demonstrate effective interview skills for roles in agriculture science.

C. **The student develops technology and digital literacy skills. The student is expected to:**
   1. Apply secure file management practices (e.g., consistent naming conventions, folder structures, backups) for handling digital documents, GIS datasets, and drone imagery.
   2. Evaluate the credibility and reliability of online resources (e.g., scientific journals, regulatory websites) to inform data-driven decisions and validate research in agriscience.
   3. Demonstrate safe and ethical use of digital platforms, including compliance with data privacy guidelines, software licensing, and responsible sharing of geospatial or aerial imagery.
   4. Collaborate using cloud-based tools (e.g., shared drives, project management apps) to coordinate tasks, exchange data, and communicate with peers or industry partners effectively.
   5. Integrate software applications (e.g., spreadsheets, GIS programs, flight planning apps) to analyze and visualize data, supporting precision agriculture, safety compliance, and decision-making.

D. **The student integrates core academic skills into networking practices. The student is expected to:**
   1. Apply algebraic or statistical methods (e.g., mean, median, regression analysis) to interpret crop yield data, livestock growth records, or safety inspection results.
   2. Compose clear and concise technical documents (e.g., research reports, standard operating procedures) that integrate proper grammar and domain-specific vocabulary.
   3. Analyze scientific texts (e.g., peer-reviewed journals, regulatory guidelines) to extract key ideas, assess credibility, and draw evidence-based conclusions for agricultural decision-making.
   4. Demonstrate scientific reasoning skills (e.g., hypothesis formulation, controlled experimentation) to investigate and solve real-world challenges in food production, environmental stewardship, or technology integration.

E. **The student demonstrates the necessary skills to integrate GIS and geospatial tools for advanced agriscience applications. The student is expected to:**
   1. Analyze geospatial data (e.g., aerial imagery, soil maps) using ArcGIS or similar platforms to identify trends in crop productivity, soil health, and resource management, expanding these analyses to forestry, parklands, or wildlife habitats for conservation planning.

2. Create digital maps and layers that display key agricultural metrics (e.g., yield data, irrigation zones), applying cartographic principles and spatial analysis, and incorporate data on protected lands, rangeland boundaries, or wildlife corridors to enhance local, state, or national park management.
3. Evaluate the accuracy of geospatial data by comparing field-collected information (e.g., GPS coordinates, soil samples) to digital sources, refining data quality where necessary, including data on species populations or environmental parameters relevant to ecosystem health.
4. Demonstrate advanced data management skills (e.g., attribute table edits, geodatabase design) for organizing and interpreting agricultural, environmental, and resource datasets, emphasizing how these skills apply to overseeing public lands, mitigating habitat loss, and safeguarding forests and waterways.

F. The student demonstrates the necessary skills to operate and apply drone technology in alignment with FAA regulations and advanced agricultural practices. The student is expected to:
1. Discuss FAA guidelines (e.g., Part 107) for drone operation, including airspace restrictions, safety protocols, and documentation requirements specific to agricultural contexts, and explore how these regulations extend to mapping and monitoring wildlife areas, coastal regions, and public parks.
2. Plan drone missions (e.g., flight paths, sensor selection) that gather high-quality imagery or multispectral data for scouting crops, monitoring livestock, or assessing natural resources, including wildlife counts, vegetation surveys, or damage assessments after natural disturbances.
3. Perform pre- and post-flight inspections, demonstrating proper drone handling, battery management, and preventive maintenance procedures, and address additional considerations (e.g., wildlife avoidance, minimal noise disruption) when operating drones in conservation areas.
4. Interpret drone-captured imagery to inform decisions on pest control, fertilization, or land use planning, aligning with regenerative agriculture and stewardship practices, while also identifying habitat conditions, invasive species presence, or forest health to support ecological conservation goals.

G. **The student demonstrates the necessary skills to synthesize advanced agriscience concepts in plant and animal production, incorporating data-driven decision-making. The student is expected to:**
1. Apply precision agriculture techniques (e.g., variable rate application, sensor-based feeding) to optimize inputs and increase efficiency while minimizing environmental impact, and explore parallel techniques in wildlife or rangeland management (e.g., targeted grazing zones, habitat enhancements).
2. Assess production outcomes (e.g., yield, feed conversion, animal welfare metrics) using statistical tools to draw conclusions and propose improvements, and discuss how similar analytical approaches support conservation of threatened species or the maintenance of balanced ecosystems.
3. Investigate cutting-edge research and industry innovations (e.g., CRISPR gene editing, automated milking systems) that can elevate production efficiency, sustainability, and animal health, and evaluate emerging technologies in land, wildlife, and marine management (e.g., wildlife genomics, real-time habitat monitoring).
4. Collaborate on a semester-long project (e.g., designing a data-driven feeding protocol, evaluating regenerative grazing practices) that integrates multiple agriscience disciplines for measurable results, incorporating components related to public land stewardship or wildlife conservation (e.g., designing grazing rotations that also protect native habitats).

H. **The student demonstrates the necessary skills to align advanced agricultural operations with sustainability and community resilience. The student is expected to:**
   1. Examine energy management strategies in agricultural operations, identifying new opportunities for renewable resources (e.g., solar pumps, anaerobic digesters) and synergy with the Energy and Natural Resources Cluster, and assess how these solutions can be adapted for park facilities or remote conservation stations.
   2. Analyze supply chain processes (e.g., processing, distribution) for plant- and animal-based products, identifying areas to reduce waste, improve safety, and enhance sustainability, and apply similar principles to recreational or conservation-based operations (e.g., park concessions, visitor centers) to minimize environmental footprints.
   3. Explore multi-faceted stewardship practices (e.g., carbon sequestration, wildlife habitat conservation, water quality improvements) that promote resilient ecosystems and rural communities, addressing the balance between ecological conservation and recreational use in local, state, or national parks.
   4. Design or participate in a community outreach project (e.g., sustainable logging demonstration, fisheries restoration) showcasing advanced agriscience knowledge, leadership, and environmental responsibility, extending this to activities like invasive species removal, forest replanting, or habitat preservation that benefit public lands and wildlife.

# Course Standards: Career Connected Learning I and II

**Career connected learning is an educational approach that integrates classroom instruction with real-world experiences, enabling high school students to explore potential careers and develop relevant skills before graduation. By participating in work-based learning opportunities—such as apprenticeships, internships, capstone projects, and school-based enterprises—students apply academic concepts in authentic settings, gain practical industry knowledge, and build professional networks. This hands-on engagement helps students connect their studies to future career paths, strengthens their problem-solving and communication skills, and supports a smoother transition into college, vocational programs, or the workforce.**

All Career and Technical Education Programs of Study include aspects of work-based learning, and almost all of the programs include two Career Connected Learning (CCL) courses. The CCL standards can be found via this link: