



Program of Study Guide: **Agriculture Science**

Comprehensive guidelines and course standards for the
Agriculture Science pathway

Office of College and Career Readiness

August 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 W. 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)

O'Marie Barnes (Student Member)

James C. Bell, Jr., Ed.D.

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

Alverne "Chet" Chesterfield

Kenny Clash

Nick Greer

Dr. Irma E. Johnson

Kim Lewis, Ed.D.

Rachel L. McCusker

Xiomara V. Medina, M.Ed.

Samir Paul, Esq.

Table of Contents

Document Control Information.....	3
Purpose.....	4
Sources of Standards.....	5
Course Descriptions.....	7
Industry-Recognized Credentials and Work-Based Learning	10
Labor Market Information: Definitions and Data	12
Course Standards: Agriculture Science I	14
Course Standards: Agriculture Crop Science II	18
Course Standards: Agriculture Crop Science III.....	22
Course Standards: Agriculture Animal Science II	26
Course Standards: Agriculture Animal Science III.....	30
Course Standards: Agriculture Animal Science IV (Veterinary Medicine).....	34

Document Control Information

Title:	Agriculture Science Program Guide
Security Level:	Approved for Distribution
File Name:	AG_Agriculture_Science

DOCUMENT HISTORY

Document Version	Date	Summary of Change
1.0	December 2024	Initial Document
2.0	April 2025	Revisions
3.0	June 2025	Revisions
4.0	August 2025	Revisions

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.

Sources of Standards

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. **BASF Plant Science Certification Blueprint – iCEV**

- A. Description: The Blueprint outlines the exam domains (plant anatomy, crop production, water & soil, IPM, sustainability) and sample competencies assessed by the BASF Plant Science Certification.
- B. Usage: Domains from the blueprint shape Crop Science II standards and the precision-ag/drones emphasis in Crop Science III, ensuring students master every tested objective before sitting for the credential.
- C. Source: [BASF Plant Science Certification - iCEV](#)

4. **Elanco Fundamentals of Animal Science Certification Blueprint – iCEV**

- A. Description: This document specifies the knowledge and skills (anatomy & physiology, genetics, nutrition, health & biosecurity, welfare) required for the Elanco certification exam.
- B. Usage: Animal Science II and III standards map directly to these domains so students complete the exam at the end of Course 2 and reinforce concepts through capstone projects in Course 3.
- C. Source: [Elanco Fundamentals of Animal Science Certification – iCEV](#)

5. University of Maryland College Park Course Catalog – PLSC 112 & ANSC 101

- A. Description: The official UMD catalog provides course descriptions for PLSC 112 *Introductory Crop Science* and ANSC 101 *Principles of Animal Science*, listing lecture topics, lab expectations, and credit details.
- B. Usage: These descriptions serve as post-secondary benchmarks; Course III standards in each pathway were backward-designed so students enter college with the prerequisite content and lab skills.
- C. Source: [PLSC 112](#) and [ANSC 101](#)

6. University of Maryland Eastern Shore (UMES) – PLSC 184 & ANPT 114

- A. Description: The UMES undergraduate catalog lists PLSC 184 Introduction to Plant Science and ANPT 114 Introduction to Animal Science, entry-level courses that emphasize fundamental biological principles, plant-environment interactions, animal production science, and the economic significance of Maryland's crop and animal industries.
- B. Usage: Course outlines serve as additional post-secondary benchmarks; specific bullets were added to Crop Science II (Standard J) and Animal Science II (Standard J) so high-school graduates enter UMES with content and lab skills that articulate to these freshman courses.
- C. Source: UMES Catalog - PLSC 184 and ANPT 114 (<https://catalog.umes.edu/>)

7. Elanco Veterinary Medical Applications Certification – iCEV

- A. Description: Elanco's Veterinary Medical Applications Certification (administered on the iCEV testing platform) validates secondary students' competence in clinical safety, anatomy & physiology, diagnostics, pharmacology, surgical assisting, and client communication required of veterinary assistants. icevonline.com
- B. Usage: The certification blueprint supplied the knowledge-and-skill domains for Veterinary Medicine IV (Standards E–J), ensuring every high-school task directly prepares students for the credential exam.
- C. Source: <https://www.icevonline.com/vet-med>

8. NAVTA Approved Veterinary Assistant (AVA) Program Guidelines – National Association of Veterinary Technicians in America

- A. Description: NAVTA's AVA guidelines specify curriculum, clinical-hour, and instructor-credential requirements for high-school and post-secondary veterinary-assistant programs that seek national approval. navta.net
- B. Usage: These requirements informed the externship hour totals, instructor-qualification notes, and clinical-skills log expectations embedded in Veterinary Medicine IV, aligning the course with pathways to AVA recognition.
- C. Source: <https://navta.net/ava-program-guidelines/>

Course Descriptions

Course Level	Course Information	Description
Required Core: Course 1	Agriculture Science I SCED: Pending Grades: 9-12 Prerequisite: None Credit: 1	This course introduces the biological, environmental, and technological principles that underpin both plant and animal systems. Students investigate cell biology, genetics, soil and water fundamentals, introductory plant and animal anatomy/physiology, and global food-system sustainability.
Required Core: Crop Science Pathway Course 2	Agriculture Science – Crop Science II SCED: Pending Grades: 10-12 Prerequisite: Agriculture Science I Credit: 1	Building on the first course, Crop Science II focuses on plant anatomy and physiology, soil fertility, integrated pest management, and sustainable field-crop production for Mid-Atlantic agriculture.
Required Core: Animal Science Pathway Course 2	Agriculture Science – Animal Science II SCED: Pending Grades: 10-12 Prerequisite: Agriculture Science I Credit: 1	This course immerses students in multi-species anatomy/physiology, genetics, reproduction, nutrition, low-stress handling, and biosecurity. Activities include vitals monitoring, ration balancing with Pearson squares or free software, facility-flow sketches, vaccine-schedule design, and in-class dosage calculations using simulators.
Optional Flex: Course 1	Agriculture Science - Crop Science III SCED: Pending Grades: 11-12 Prerequisite: Agriculture Science I & Crop Science II Credit: 1	The course deepens students' mastery of crop morphology, ecophysiology, genomics-aided breeding, precision agriculture, and climate-smart conservation practices.
Optional Flex: Course 1	Agriculture Science - Animal Science III SCED: Pending Grades: 11-12 Prerequisite: Agriculture Science I & Animal Science II Credit: 1	This course integrates advanced physiology, quantitative genetics, biotechnology, applied nutrition, holistic health management, welfare auditing, product-quality grading, and enterprise economics.

Course Level	Course Information	Description
Optional Flex: Course 2	Agriculture Science – Animal Science IV (Veterinary Medicine) SCED: Pending Grades: 12 Prerequisite: Agriculture Science I, Animal Science II and III Credit: 1	This senior-level course immerses students in the essential knowledge and hands-on skills of small- and large-animal clinical practice while preparing them for the Elanco Fundamentals of Veterinary Medicine certification. Learners refine their comparative anatomy and physiology through patient assessment labs; practice restraint, surgical-site preparation, dosage calculations, and basic laboratory diagnostics on mannequins and simulation stations; and apply safety, biosecurity, and legal protocols consistent with Maryland's veterinary-practice regulations.
Optional Flex: Course 2	Career Connected Learning I SCED: Pending Grades: 11-12 Prerequisite: See Course Description Credits: 1-3	Prerequisites: 1. Alignment to the student's 6-Year Plan 2. Completion of: a. Minimum two sequential courses in a CTE pathway, OR b. Minimum two years of the same world language; OR c. Minimum two sequential courses in a comprehensive arts program; OR d. Inclusion in the IEP/504 transition plan with supporting documentation (as required) 3. Endorsement from an educator, mentor, employer, or career coach 4. No more than one course recovery credit in core subjects is needed by the student. 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 practices. 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-

Course Level	Course Information	Description
		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 SCED: Pending Grades: 11-12 Prerequisite: Career Connected Learning I Credits: 1-3	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 Career-Connected Learning

The *Blueprint for Maryland's Future* and the High School Level of a Registered Apprenticeship

The Maryland State Department of Education recognizes the high-school level of a Registered Apprenticeship (RA), defined as a State-approved Registered Apprenticeship begun during high school in which students complete at least 144 hours of related technical instruction and 250 hours of paid on-the-job training before graduation, with the remaining required apprenticeship hours completed post-graduation, as the gold standard of Career Connected Learning.

The CTE Committee of the Governor’s Workforce Development Board, in alignment with federal apprenticeship standards, requires 144 hours of RTI for all high school RA participants, and the Apprenticeship Maryland Program (AMP) defines the minimum RTI as **one course credit equivalent**. This high-school-level Registered Apprenticeship is the preferred career-connected learning option for students to meet the Blueprint’s goal that 45% of public high school graduates complete either the high-school level of a Registered Apprenticeship or another industry-recognized credential.

To the extent practicable, the greatest number of students should achieve this goal through participation in a high-school level Registered Apprenticeship, with schools ensuring these requirements are scheduled, completed, and documented for transcript and reporting purposes.

To the extent practicable, the greatest number of students should achieve this goal through the high-school level of a Registered Apprenticeship.

Career-Connected Learning Resources		
Course 1: Career Awareness	Course 2: Career Preparation	Flex Courses: Career-Connected Learning
- Industry Visits - Guest Speakers - Participation in Career and Technical Student Organizations - Postsecondary Visits – Program Specific Site Tours - Mock Interviews	- All of Career Awareness plus the following: - Job Shadow - Employer Mentoring	- Registered Apprenticeship - Internship - School-Based Enterprise - Employer-Directed Capstone

Industry-Recognized Credentials: – The standards in this document are aligned to the following certifications:

By the end of Agriculture Science II:

- Crop Science II – BASF Plant Science Certification
- Elanco Animal Science Certification

By the end of Agriculture Science IV: Elanco Vet Medicine

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 Wage¹	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). <i>Note: A 25th percentile hourly wage of \$24.74 or greater is required to meet this definition.</i>	Standard Occupational Code: 19-1011 – Animal Scientists 19-1013 – Soil and Plant Scientists Hourly Wage/Annual Salary: 25 th Percentile: \$28.38 / \$59,034.00 50 th Percentile: \$35.49 / \$73,809.00 75 th Percentile: \$47.83 / \$99,483.00
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: Animal and soil and plant scientists typically need a bachelor's degree in a agriculture or a related field, such as biology or chemistry.
In-Demand	Annual growth plus replacement, across all Maryland occupations, is <u>405</u> openings between 2024-2029.	Annual Openings 42

Lightcast Data Updated August 2025

¹ Living Wage Calculator: <https://livingwage.mit.edu/states/24>

Labor Market Information Data Source

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 & Technical Education Program of Study begins with Agriculture Science I, a common foundations course covering plant and animal biology, soils, water, and sustainable food systems. From there, districts may offer one or both two-course pathways: Crop Science II–III, which prepares students for the BASF Plant Science certification while using drone and satellite imagery in labs that align with both the University of Maryland’s PLSC 112 Introductory Crop Science and the University of Maryland Eastern Shore’s PLSC 184 Introduction to Plant Science; and Animal Science II–III, which culminates in the Elanco Fundamentals of Animal Science credential and capstone projects that map to UMD’s ANSC 101 Principles of Animal Science as well as UMES’s ANPT 114 Introduction to Animal Science. The Animal Science pathway also lays the academic and clinical groundwork for an optional fourth-level Veterinary Medicine IV course, enabling students to pursue the Elanco Veterinary Medicine certification.
 - D. In Agriculture Science I, students complete Hands-on labs include soil pH testing, basic microscopy, small-plot cultivation, and low-stress animal-handling demonstrations. FFA leadership, career exploration, and a supervised agricultural experience proposal help students decide between the Crop Science or Animal Science pathway for Course 2. Completion of Agriculture Science I establishes half of the knowledge base required for either the BASF Plant Science or Elanco Animal Science certification.
 - 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., clear naming conventions, logical folder structures, routine backups, and version control) when handling digital documents, GIS layers, sensor logs, and drone imagery.
2. Evaluate the credibility and reliability of online resources—such as peer-reviewed journals, extension databases, and regulatory websites—to inform agriscience decisions and validate research findings.
3. Demonstrate safe, ethical, and legal use of digital platforms by following data-privacy laws, honoring software licenses and fair-use guidelines, and sharing geospatial or aerial imagery responsibly.
4. Collaborate effectively through cloud-based tools (shared drives, real-time documents, virtual whiteboards, project-management apps) to coordinate tasks, exchange data, and communicate with peers, mentors, and industry partners.
5. Integrate multiple software applications (spreadsheets, GIS programs, drone-flight planners, sensor dashboards, and basic statistical packages) to analyze and visualize data that support precision agriculture, animal-enterprise management, and sustainability decisions.

D. The student integrates core academic skills into agriculture science practices. The student is expected to:

1. Apply mathematical concepts—including ratio, proportion, algebraic equations, and introductory statistics—to balance livestock rations, calibrate field equipment, compute medication dosages, and analyze yield- or growth-rate data.

2. Design and conduct scientific investigations by formulating testable hypotheses, controlling variables, collecting quantitative and qualitative data, and interpreting results with spreadsheets or graphing tools.
3. Produce clear, well-organized technical documents (lab reports, research briefs, standard-operating procedures) that follow accepted formatting and citation styles such as APA or MLA.
4. Read, interpret, and synthesize complex informational texts (peer-reviewed articles, extension bulletins, regulatory guidelines, product labels) to support evidence-based decision-making in crop and animal sciences.
5. Present findings to diverse audiences through oral presentations, data-rich posters, and multimedia formats, employing effective visuals, precise terminology, and audience-appropriate explanations.

E. The student demonstrates the necessary skills to apply the scientific method and maintain safe, ethical practices in crop- and animal-science laboratories. The student is expected to:

1. Formulate testable questions, hypotheses, and data-collection plans for experiments involving living plants and animals.
2. Select and correctly use common agriscience tools (pH meters, microscopes, grain-moisture testers, livestock scales, etc.), recording measurements with appropriate SI units.
3. Practice laboratory, field, and animal-handling safety—including PPE, biosecurity zones, SDS use, and humane care codes—consistent with OSHA and FFA standards.
4. Analyze experimental data with spreadsheets or handheld devices, interpret results, and communicate findings in technical reports that follow APA style.
5. Demonstrate ethical decision-making when handling living organisms and agricultural resources, referencing current USDA and EPA regulations.

F. The student demonstrates the necessary skills to explain core biological principles that underpin both crop and animal systems. The student is expected to:

1. Compare plant and animal cell structures, explaining photosynthesis, respiration, and digestion as energy-conversion processes.
2. Diagram the life cycles of a major crop (e.g., corn) and a livestock species (e.g., beef cattle), identifying key growth stages and husbandry requirements.
3. Illustrate basic Mendelian inheritance and apply Punnett squares to predict plant traits and animal coat-color outcomes.
4. Relate the role of DNA technology (tissue culture, genomic selection) in modern plant improvement and animal breeding.
5. Evaluate how environmental factors (light, temperature, water, nutrition) influence plant growth and animal performance.

G. The student demonstrates the necessary skills to analyze plant- and soil-system interactions that drive sustainable crop production. The student is expected to:

1. Identify major agronomic crops grown in the Mid-Atlantic region and describe their anatomy, morphology, and economic importance.
2. Characterize Mid-Atlantic soil profiles, test soil pH & nutrient status, and recommend basic fertility and liming programs.
3. Describe integrated pest-management (IPM) strategies—cultural, biological, and chemical—for weeds, insects, and diseases highlighted in the BASF blueprint.
4. Explain watershed concepts and water-quality BMPs (buffer strips, nutrient-management plans) that meet state conservation standards.
5. Use precision-ag tools (hand-held GPS, remote sensing apps) to map a field, calculate plant populations, and propose variable-rate seeding or fertilization.

H. The student demonstrates the necessary skills to analyze biological, nutritional, and welfare principles that govern responsible animal production. The student is expected to:

1. Classify livestock species and breeds common to Maryland; describe their anatomy, physiology, and primary products.
2. Compare monogastric and ruminant digestive systems and relate feed components (water, carbohydrates, proteins, fats, minerals, vitamins) to growth and health.
3. Outline basic reproductive anatomy, estrous cycles, and assisted-reproduction technologies introduced in the Elanco blueprint.
4. Recognize clinical signs of common diseases; explain biosecurity, vaccination, and parasite-control plans for beef, dairy, swine, sheep, and poultry.
5. Demonstrate low-stress animal-handling techniques and discuss the Five Freedoms framework for animal welfare.

I. The student demonstrates the necessary skills to evaluate sustainable practices, emerging technologies, and career pathways in global food systems. The student is expected to:

1. Compare carbon-footprint and resource-use data for conventional, regenerative, and precision-ag production models.
2. Interpret basic regulations and policies governing pesticides, antibiotics, nutrient management, and animal welfare at the state and federal levels.
3. Use career-exploration software to map postsecondary options—including BASF Plant Science or Elanco Animal Science certification, UMD majors (PLSC, ANSC), apprenticeships, and two- or four-year degrees—into a personal plan of study.
4. Participate in an FFA Career Development Event (Ag Issues, Environmental & Natural Resources, Livestock Judging, or Agronomy) and reflect on the technical and leadership skills demonstrated.
5. Develop a Supervised Agricultural Experience (SAE) proposal—crop or animal focused—that sets measurable goals for completion in Course 2 and supports certification evidence requirements.

Course Standards: Agriculture Crop 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 & Technical Education Program of Study begins with Agriculture Science I, a common foundations course covering plant and animal biology, soils, water, and sustainable food systems. From there, districts may offer one or both two-course pathways: Crop Science II–III, which prepares students for the BASF Plant Science certification while using drone and satellite imagery in labs that align with both the University of Maryland's PLSC 112 Introductory Crop Science and the University of Maryland Eastern Shore's PLSC 184 Introduction to Plant Science; and Animal Science II–III, which culminates in the Elanco Fundamentals of Animal Science credential and capstone projects that map to UMD's ANSC 101 Principles of Animal Science as well as UMES's ANPT 114 Introduction to Animal Science. The Animal Science pathway also lays the academic and clinical groundwork for an optional fourth-level Veterinary Medicine IV course, enabling students to pursue the Elanco Veterinary Medicine certification.
 - D. In Agriculture Science – Crop Science II, students collect and interpret soil and tissue tests, calibrate (model) sprayers, calculate seeding and fertilizer rates, and explore precision-ag tools such as phone-based GIS mapping. By spring, students review BASF Plant Science blueprint domains and sit for the certification exam. All performance tasks map directly to the lecture and lab topics found in the University of Maryland's PLSC 112 Introductory Crop Science course.
 - 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., clear naming conventions, logical folder structures, routine backups, and version control) when handling digital documents, GIS layers, sensor logs, and drone imagery.
2. Evaluate the credibility and reliability of online resources—such as peer-reviewed journals, extension databases, and regulatory websites—to inform agriscience decisions and validate research findings.
3. Demonstrate safe, ethical, and legal use of digital platforms by following data-privacy laws, honoring software licenses and fair-use guidelines, and sharing geospatial or aerial imagery responsibly.
4. Collaborate effectively through cloud-based tools (shared drives, real-time documents, virtual whiteboards, project-management apps) to coordinate tasks, exchange data, and communicate with peers, mentors, and industry partners.
5. Integrate multiple software applications (spreadsheets, GIS programs, drone-flight planners, sensor dashboards, and basic statistical packages) to analyze and visualize data that support precision agriculture, animal-enterprise management, and sustainability decisions.

D. The student integrates core academic skills into plant science practices. The student is expected to:

1. Apply mathematical concepts—including ratio, proportion, algebraic equations, and introductory statistics—to balance livestock rations, calibrate field equipment, compute medication dosages, and analyze yield- or growth-rate data.
2. Design and conduct scientific investigations by formulating testable hypotheses, controlling variables, collecting quantitative and qualitative data, and interpreting results with spreadsheets or graphing tools.
3. Produce clear, well-organized technical documents (lab reports, research briefs, standard-operating procedures) that follow accepted formatting and citation styles such as APA or MLA.

4. Read, interpret, and synthesize complex informational texts (peer-reviewed articles, extension bulletins, regulatory guidelines, product labels) to support evidence-based decision-making in crop and animal sciences.
5. Present findings to diverse audiences through oral presentations, data-rich posters, and multimedia formats, employing effective visuals, precise terminology, and audience-appropriate explanations

E. The student demonstrates the necessary skills to analyze the structure and function of crop plants and relate key physiological processes to growth and adaptation. The student is expected to:

1. Identify and label roots, stems, leaves, flowers, fruits, and seeds of major Mid-Atlantic field and horticultural crops, explaining their functions in photosynthesis, respiration, and reproduction.
2. Compare C3, C4, and CAM photosynthetic pathways and infer how each influences geographic adaptation and water-use efficiency.
3. Measure photosynthetic rate or relative chlorophyll content with a classroom leaf-disk assay or a smartphone/SPAD meter, recording data with SI units in a standardized lab report.
4. Explain how environmental factors (light, temperature, water, nutrients) and plant-growth regulators affect germination, vegetative growth, flowering, and senescence.
5. Evaluate plant health using diagnostic keys and relate visible symptoms to underlying physiological disorders (e.g., chlorosis linked to Fe deficiency). [A Comprehensive CTE Solutionapp.testudo.umd.edu](https://www.testudo.umd.edu/cte/solutions).

F. The student demonstrates the necessary skills to apply genetic principles and modern biotechnology to crop improvement. The student is expected to:

1. Predict monohybrid and dihybrid segregation ratios using Punnett squares and explain the genetic basis of hybrid vigor in staple crops such as corn.
2. Interpret sample marker-assisted-selection data provided by a seed company (tables or gel images) to confirm inheritance of selected alleles—no wet-lab DNA extraction required.
3. Design a small-plot breeding experiment that selects for a target trait (e.g., disease resistance), including data-collection and statistical-analysis plans.
4. Interpret basic molecular data (gel images or SNP tables) to confirm inheritance of selected alleles.
5. Describe germplasm preservation strategies (seed banks, in-situ conservation) and their role in global food security.

G. The student demonstrates the necessary skills to plan, establish, and manage sustainable crop-production systems. The student is expected to:

1. Collect and analyze soil samples for texture, pH, organic matter, and macronutrients; recommend lime and fertilizer rates using regional extension guidelines.
2. Calculate seeding rates and plant populations for corn, soybean, wheat, and one specialty crop, adjusting for germination percentage and row spacing.
3. Compare conventional, conservation-tillage, and no-till systems, assessing their effects on soil health, fuel use, and greenhouse-gas emissions.
4. Map a field or school garden with a handheld GPS unit or free phone-based GIS app to illustrate variable-rate seeding/fertilizer zones.
5. Describe post-harvest handling, storage, and quality-assurance practices that maintain crop value and reduce losses. [A Comprehensive CTE Solutionapp.testudo.umd.edu](https://www.testudo.umd.edu/cte/solutions).

H. The student demonstrates the necessary skills to diagnose crop pests and nutrient problems and implement safe, effective control strategies. The student is expected to:

1. Identify common Mid-Atlantic weeds, insect pests, and diseases using dichotomous keys or digital diagnostics; describe their life cycles and economic thresholds.
2. Develop an IPM plan that integrates cultural, biological, mechanical, and chemical tactics, including resistance-management and pollinator-protection practices.
3. Perform mock sprayer calibration on a tabletop spray-boom model or full-size equipment if available; compute pesticide rates in compliance with label directions.
4. Use plant-tissue or sap tests to detect nutrient deficiencies and propose corrective fertilization or foliar-feeding strategies.
5. Evaluate environmental risks (runoff, volatilization, worker exposure) and outline mitigation measures such as vegetative buffer strips and personal protective equipment.

I. The student demonstrates the necessary skills to manage water resources efficiently and protect environmental quality in crop systems. The student is expected to:

1. Define watershed boundaries for a school-based field site and measure key water-quality parameters (pH, turbidity, nitrates).
2. Design an irrigation schedule using evapotranspiration data, soil-moisture sensors, or crop-growth stages to maximize water-use efficiency.
3. Compare surface, sprinkler, drip, and subsurface-drip irrigation methods for capital cost, labor, and water savings.
4. Explain how cover crops, contour farming, vegetative buffers, and nutrient-management plans reduce erosion and non-point-source pollution.
5. Calculate estimated carbon sequestration or greenhouse-gas reduction attributable to conservation tillage or cover-crop adoption. [A Comprehensive CTE Solution.](#)

J. The student demonstrates the necessary skills to evaluate the historical development, economic importance, and cultural significance of major crops. The student is expected to:

1. Trace the domestication pathways of corn, wheat, and soybeans, highlighting centers of origin and key genetic improvements.
2. Analyze regional and global market trends for at least two commodity crops, using USDA or FAO data to calculate breakeven prices and gross margins.
3. Discuss how policies (e.g., biofuel mandates, GMO labeling) and trade agreements influence crop choices and profitability for U.S. producers.
4. Create an outreach artifact (podcast, infographic, or FFA Ag-Issues presentation) that communicates the socio-economic impact of a chosen crop on local communities.
5. Update the student's Supervised Agricultural Experience (SAE) record book to include crop-production data and reflections aligned to BASF certification evidence requirements.
6. Evaluate the economic contribution of Maryland's field, horticultural, and nursery industries to state GDP and employment.
7. Assess how common Mid-Atlantic crop-production practices affect Chesapeake Bay water quality, soil health, and wildlife habitat, proposing BMPs that mitigate negative effects.

Course Standards: Agriculture Crop 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 & Technical Education Program of Study begins with Agriculture Science I, a common foundations course covering plant and animal biology, soils, water, and sustainable food systems. From there, districts may offer one or both two-course pathways: Crop Science II–III, which prepares students for the BASF Plant Science certification while using drone and satellite imagery in labs that align with both the University of Maryland’s PLSC 112 Introductory Crop Science and the University of Maryland Eastern Shore’s PLSC 184 Introduction to Plant Science; and Animal Science II–III, which culminates in the Elanco Fundamentals of Animal Science credential and capstone projects that map to UMD’s ANSC 101 Principles of Animal Science as well as UMES’s ANPT 114 Introduction to Animal Science. The Animal Science pathway also lays the academic and clinical groundwork for an optional fourth-level Veterinary Medicine IV course, enabling students to pursue the Elanco Veterinary Medicine certification.
 - D. In Agriculture Science III, learners analyze drone or satellite imagery, build prescription maps, compare gene-editing and conventional breeding strategies, and complete a capstone research project presented at an FFA Agriscience Fair or local symposium. Economic analysis of carbon-smart practices and global commodity trends prepares students for collegiate agronomy labs.
 - 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., clear naming conventions, logical folder structures, routine backups, and version control) when handling digital documents, GIS layers, sensor logs, and drone imagery.
2. Evaluate the credibility and reliability of online resources—such as peer-reviewed journals, extension databases, and regulatory websites—to inform agriscience decisions and validate research findings.
3. Demonstrate safe, ethical, and legal use of digital platforms by following data-privacy laws, honoring software licenses and fair-use guidelines, and sharing geospatial or aerial imagery responsibly.
4. Collaborate effectively through cloud-based tools (shared drives, real-time documents, virtual whiteboards, project-management apps) to coordinate tasks, exchange data, and communicate with peers, mentors, and industry partners.
5. Integrate multiple software applications (spreadsheets, GIS programs, drone-flight planners, sensor dashboards, and basic statistical packages) to analyze and visualize data that support precision agriculture, animal-enterprise management, and sustainability decisions.

D. The student integrates core academic skills into plant science practices. The student is expected to:

1. Apply mathematical concepts—including ratio, proportion, algebraic equations, and introductory statistics—to balance livestock rations, calibrate field equipment, compute medication dosages, and analyze yield- or growth-rate data.
2. Design and conduct scientific investigations by formulating testable hypotheses, controlling variables, collecting quantitative and qualitative data, and interpreting results with spreadsheets or graphing tools.
3. Produce clear, well-organized technical documents (lab reports, research briefs, standard-operating procedures) that follow accepted formatting and citation styles such as APA or MLA.

4. Read, interpret, and synthesize complex informational texts (peer-reviewed articles, extension bulletins, regulatory guidelines, product labels) to support evidence-based decision-making in crop and animal sciences.
5. Present findings to diverse audiences through oral presentations, data-rich posters, and multimedia formats, employing effective visuals, precise terminology, and audience-appropriate explanations.

E. The student demonstrates the necessary skills to evaluate how complex anatomical and morphological traits influence crop performance under variable environments.

1. Dissect and microscopically compare vascular arrangements, root architectures, and reproductive structures of C3, C4, and CAM crops, relating form to resource capture and stress tolerance.
2. Estimate photosynthetic or transpiration rates with a free smartphone gas-exchange app or share an IRGA sensor borrowed from an extension partner; analyze genotype × environment interactions.
3. Model phenological development (growing-degree-days) for three regional crops and predict shifts under projected climate scenarios.
4. Correlate anatomical adaptations (e.g., aerenchyma, leaf pubescence) with ecological niches—from flooded rice paddies to semi-arid sorghum fields.
5. Present findings in a scientific poster that interprets how morphology and physiology guide varietal selection and cultural practices. [University of Maryland Catalog](#)[Testudo](#).

F. The student demonstrates the necessary skills to design and critique modern crop-improvement strategies that enhance yield, quality, and resilience. The student is expected to:

1. Construct a breeding scheme that integrates conventional hybridization with marker-assisted or CRISPR-based selection for a target trait (e.g., disease resistance).
2. Analyze simplified SNP tables (provided by the teacher or online database) to identify candidate alleles—no commercial bioinformatics license required.
3. Evaluate regulatory frameworks and public-perception issues surrounding genetically modified and gene-edited crops; debate ethical considerations in a structured Socratic seminar.
4. Explain how doubled-haploid, speed-breeding, and participatory-breeding methods accelerate genetic gain in public and private programs.
5. Curate a seed-bank proposal that documents heritage varieties, defines rejuvenation protocols, and justifies conservation for future food-security needs. [University of Maryland Catalog](#).

G. The student demonstrates the necessary skills to deploy geospatial and sensor technologies for site-specific crop management decisions. The student is expected to:

1. Collect multispectral imagery using a shared drone or free Sentinel satellite data; calculate NDVI or NDRE indices and delineate within-field management zones.
2. Build a prescription map that integrates yield-monitor data, soil grids, and remote-sensing layers to variable-rate seed, fertilizer, or irrigation applications.
3. Demonstrate GPS guidance accuracy with a school tractor or desktop simulator if RTK equipment is not accessible.
4. Perform economic and environmental ROI analyses comparing blanket vs. site-specific inputs for one commodity crop.
5. Document the workflow in a digital agronomy log that meets BASF Plant Science evidence requirements and supports articulation to university lab expectations.

H. The student demonstrates the necessary skills to design whole-farm systems that balance productivity, resource stewardship, and climate-smart goals. The student is expected to:

1. Conduct a whole-farm carbon and nutrient audit; propose practices (cover crops, reduced tillage, biochar) that lower greenhouse-gas intensity.
2. Compare integrated crop–livestock, alley-cropping, and perennial-grain systems for biodiversity, soil health, and net returns.
3. Develop a water-budget model that pairs deficit-irrigation strategies with drought-tolerant genetics for climate-risk mitigation.
4. Evaluate policy instruments (e.g., USDA Climate-Smart Commodities, carbon markets) that incentivize sustainable production; write a policy brief for a local producer.
5. Implement and monitor a conservation practice on the school farm or SAE site; analyze pre- and post-practice soil- or water-quality metrics.

Digital Commons

I. The student demonstrates the necessary skills to assess how historical domestication, cultural contexts, and market forces shape modern crop systems. The student is expected to:

1. Produce a comparative timeline of wheat, maize, rice, and soybean domestication, highlighting key genetic bottlenecks and diffusion routes.
2. Analyze global supply-and-demand datasets (USDA/FAS, FAO) to explain price volatility and its impact on producer decision-making.
3. Investigate cultural uses of a selected staple in gastronomy, ritual, and identity; present an oral history interview or mini-documentary.
4. Model the ripple effects of trade barriers or phytosanitary regulations on regional cropping patterns.
5. Update SAE financial records to include enterprise budgets, cost-of-production, and gross-margin calculations aligned with GenEd expectations of PLSC 112.

J. The student demonstrates the necessary skills to synthesize crop-science knowledge through inquiry, professional documentation, and leadership activities. The student is expected to:

1. Design and execute an independent or team research trial aligned to one of the Standards E–H themes; apply appropriate statistical analyses (ANOVA, regression).
2. Write a formal research paper modeled on PLSC 112 lab-report guidelines or create a shortened scientific brief if class time is limited.
3. Deliver a conference-style presentation or poster at an FFA Agriscience Fair, state science expo, or university field day; respond to judge questions with evidence-based arguments.
4. Assemble a digital portfolio containing certification credential, SAE records, project abstracts, and reflective essays; map artifacts to PLSC 112 learning objectives.
5. Develop an individualized post-secondary plan outlining dual-enrollment options, scholarship opportunities, and undergraduate research prospects in agronomy or plant science.

Course Standards: Agriculture Animal Science II

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 & Technical Education Program of Study begins with Agriculture Science I, a common foundations course covering plant and animal biology, soils, water, and sustainable food systems. From there, districts may offer one or both two-course pathways: Crop Science II–III, which prepares students for the BASF Plant Science certification while using drone and satellite imagery in labs that align with both the University of Maryland’s PLSC 112 Introductory Crop Science and the University of Maryland Eastern Shore’s PLSC 184 Introduction to Plant Science; and Animal Science II–III, which culminates in the Elanco Fundamentals of Animal Science credential and capstone projects that map to UMD’s ANSC 101 Principles of Animal Science as well as UMES’s ANPT 114 Introduction to Animal Science. The Animal Science pathway also lays the academic and clinical groundwork for an optional fourth-level Veterinary Medicine IV course, enabling students to pursue the Elanco Veterinary Medicine certification.
 - D. Agriculture Animal Science II coursework aligns to every Elanco Fundamentals of Animal Science exam domain, and students test for the credential at year’s end. Standards mirror the breadth of UMD’s ANSC 101 Principles of Animal Science, giving students a solid bridge from secondary to post-secondary study.
 - 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., clear naming conventions, logical folder structures, routine backups, and version control) when handling digital documents, GIS layers, sensor logs, and drone imagery.
2. Evaluate the credibility and reliability of online resources—such as peer-reviewed journals, extension databases, and regulatory websites—to inform agriscience decisions and validate research findings.
3. Demonstrate safe, ethical, and legal use of digital platforms by following data-privacy laws, honoring software licenses and fair-use guidelines, and sharing geospatial or aerial imagery responsibly.
4. Collaborate effectively through cloud-based tools (shared drives, real-time documents, virtual whiteboards, project-management apps) to coordinate tasks, exchange data, and communicate with peers, mentors, and industry partners.
5. Integrate multiple software applications (spreadsheets, GIS programs, drone-flight planners, sensor dashboards, and basic statistical packages) to analyze and visualize data that support precision agriculture, animal-enterprise management, and sustainability decisions.

D. The student integrates core academic skills into animal science practices. The student is expected to:

1. Apply mathematical concepts—including ratio, proportion, algebraic equations, and introductory statistics—to balance livestock rations, calibrate field equipment, compute medication dosages, and analyze yield- or growth-rate data.
2. Design and conduct scientific investigations by formulating testable hypotheses, controlling variables, collecting quantitative and qualitative data, and interpreting results with spreadsheets or graphing tools.
3. Produce clear, well-organized technical documents (lab reports, research briefs, standard-operating procedures) that follow accepted formatting and citation styles such as APA or MLA.

4. Read, interpret, and synthesize complex informational texts (peer-reviewed articles, extension bulletins, regulatory guidelines, product labels) to support evidence-based decision-making in crop and animal sciences.
5. Present findings to diverse audiences through oral presentations, data-rich posters, and multimedia formats, employing effective visuals, precise terminology, and audience-appropriate explanations.

E. The student demonstrates the necessary skills to describe and measure the form-and-function relationships that govern animal growth, performance, and health. The student is expected to:

1. Identify major external and internal anatomical landmarks of cattle, swine, sheep, poultry, horses, dogs, and cats using charts, 3-D models, or palpation on live animals when appropriate.
2. Compare monogastric, ruminant, and avian digestive systems, relating structural differences to feed-utilization efficiency and product type (meat, milk, eggs, fiber).
3. Measure heart rate, respiration, and body temperature before and after calm handling; graph results to explain homeostatic regulation.
4. Explain the role of endocrine hormones (growth, reproductive, stress) in regulating development and productivity.
5. Relate species-specific anatomical and physiological adaptations to their use in food, companion, research, or exhibition settings.

F. The student demonstrates the necessary skills to apply genetic principles and reproductive technologies that improve animal populations. The student is expected to:

1. Use Punnett squares and simple heritability calculations to predict coat-color, polledness, or growth traits in livestock and companion animals.
2. Interpret Expected Progeny Difference (EPD) or Estimated Breeding Value (EBV) tables using teacher-supplied example datasets; record decisions on a templated worksheet to design a mating plan that meets a stated production goal (e.g., weaning weight, milk yield).
3. Compare artificial insemination, estrus synchronization, embryo transfer, and genomic selection; outline equipment, cost, and success rates for each using an instructor-provided comparison chart.
4. Summarize reproductive cycles and gestation lengths across bovine, porcine, ovine, caprine, avian, and canine species; create a management calendar for one chosen species.
5. Debate ethical, welfare, and regulatory considerations surrounding cloning and gene editing in food-animal production, citing current policy documents.

G. The student demonstrates the necessary skills to formulate balanced rations that meet the nutrient requirements of diverse species and production stages. The student is expected to:

1. Classify common feedstuffs (forage, concentrate, by-product) by nutrient profile and origin; match feeds to appropriate species and life stages.
2. Determine dry-matter content with a microwave-drying method and interpret a commercial lab report for crude protein, energy, and fiber.
3. Use the Pearson square or free web-based software to balance a grower ration for swine and a replacement-heifer ration for dairy cattle.
4. Evaluate feeders and waterers for accessibility, waste reduction, and biosecurity; recommend improvements where needed.
5. Explain how nutrition influences growth rate, feed efficiency, reproduction, and carcass composition, citing current extension or peer-reviewed research.

H. The student demonstrates the necessary skills to maintain animal well-being through preventive medicine, safe handling, and disease-control protocols. The student is expected to:

1. Identify clinical signs of common infectious, parasitic, metabolic, and nutritional disorders; classify each by causal agent or deficiency.
2. Create a herd/flock health plan—using a structured template—that lists vaccination, deworming, and hoof-care schedules consistent with veterinarian-client-patient-relationship (VCPR) guidelines.
3. Calculate therapeutic dosages from drug-label directions and practice intramuscular, subcutaneous, and oral administration on inert materials (e.g., oranges, injection simulators) while wearing appropriate PPE under teacher supervision.
4. Design a biosecurity protocol—including traffic control, sanitation, quarantine, and wildlife exclusion—for a local animal enterprise; present the plan in infographic format.
5. Apply the Five Freedoms, Humane Slaughter Act, and industry audit criteria to evaluate animal-care practices and facility compliance; document findings on a checklist provided by the instructor.

I. The student demonstrates the necessary skills to interpret animal behavior and apply low-stress handling techniques in species-appropriate facilities. The student is expected to:

1. Explain flight zone, point of balance, and herd/flock instinct in cattle, sheep, goats, swine, poultry, and horses.
2. Safely halter, lead, sort, or load animals using voice, visual, and tactile cues that minimize stress.
3. Assess chutes, alleys, parlors, kennels, or cages for animal flow and handler safety; create a hand-drawn layout (or use a free online chute-design tool) showing recommended modifications.
4. Record behavioral observations (vocalizations, posture, avoidance distance) and correlate them with physiological stress indicators collected in Standard E-3.
5. Compare behavior-based management in livestock operations with practices used in zoos, laboratories, and companion-animal shelters.

J. The student demonstrates the necessary skills to connect production practices to product quality, economics, and professional opportunities in animal science. The student is expected to:

1. Outline production cycles, performance targets, and key performance indicators (KPIs) for beef, dairy, pork, poultry, small-ruminant, aquaculture, and companion-animal sectors.
2. Grade virtual or physical carcass specimens for yield and quality; relate live-animal management decisions to carcass outcomes.
3. Calculate feed-conversion ratio, break-even price, and gross margin for a chosen species using current market data.
4. Summarize federal regulations and quality-assurance programs governing antibiotic use, residue testing, humane handling, and product labeling.
5. Develop a Supervised Agricultural Experience (SAE) or FFA Proficiency plan in an animal-science area, linking required artifacts to the Elanco certification evidence checklist and to ANSC 101 learning objectives.
6. Analyze the nutritional, cultural, and economic importance of major animal products (meat, milk, eggs, fiber, service animals) to U.S. and global consumers, citing current consumption data.

Course Standards: Agriculture Animal 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 & Technical Education Program of Study begins with Agriculture Science I, a common foundations course covering plant and animal biology, soils, water, and sustainable food systems. From there, districts may offer one or both two-course pathways: Crop Science II–III, which prepares students for the BASF Plant Science certification while using drone and satellite imagery in labs that align with both the University of Maryland’s PLSC 112 Introductory Crop Science and the University of Maryland Eastern Shore’s PLSC 184 Introduction to Plant Science; and Animal Science II–III, which culminates in the Elanco Fundamentals of Animal Science credential and capstone projects that map to UMD’s ANSC 101 Principles of Animal Science as well as UMES’s ANPT 114 Introduction to Animal Science. The Animal Science pathway also lays the academic and clinical groundwork for an optional fourth-level Veterinary Medicine IV course, enabling students to pursue the Elanco Veterinary Medicine certification.
 - D. In Agriculture Animal Science III capstone projects might compare feed-additive effects on growth, audit a local operation for Beef Quality Assurance compliance, or produce a business plan for a student-run livestock enterprise. Deliverables include a scientific poster or short video presentation, a polished digital portfolio, and an individualized post-secondary transition plan aligned to ANSC 101 competencies and animal-science career pathways.
 - 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., clear naming conventions, logical folder structures, routine backups, and version control) when handling digital documents, GIS layers, sensor logs, and drone imagery.
2. Evaluate the credibility and reliability of online resources—such as peer-reviewed journals, extension databases, and regulatory websites—to inform agriscience decisions and validate research findings.
3. Demonstrate safe, ethical, and legal use of digital platforms by following data-privacy laws, honoring software licenses and fair-use guidelines, and sharing geospatial or aerial imagery responsibly.
4. Collaborate effectively through cloud-based tools (shared drives, real-time documents, virtual whiteboards, project-management apps) to coordinate tasks, exchange data, and communicate with peers, mentors, and industry partners.
5. Integrate multiple software applications (spreadsheets, GIS programs, drone-flight planners, sensor dashboards, and basic statistical packages) to analyze and visualize data that support precision agriculture, animal-enterprise management, and sustainability decisions.

D. The student integrates core academic skills into animal science practices. The student is expected to:

1. Apply mathematical concepts—including ratio, proportion, algebraic equations, and introductory statistics—to balance livestock rations, calibrate field equipment, compute medication dosages, and analyze yield- or growth-rate data.
2. Design and conduct scientific investigations by formulating testable hypotheses, controlling variables, collecting quantitative and qualitative data, and interpreting results with spreadsheets or graphing tools.
3. Produce clear, well-organized technical documents (lab reports, research briefs, standard-operating procedures) that follow accepted formatting and citation styles such as APA or MLA.

4. Read, interpret, and synthesize complex informational texts (peer-reviewed articles, extension bulletins, regulatory guidelines, product labels) to support evidence-based decision-making in crop and animal sciences.
5. Present findings to diverse audiences through oral presentations, data-rich posters, and multimedia formats, employing effective visuals, precise terminology, and audience-appropriate explanations.

E. The student demonstrates the necessary skills to relate anatomical specialization and physiological regulation to animal adaptation, productivity, and welfare. The student is expected to:

1. Compare musculoskeletal adaptations for locomotion in poultry, horses, dogs, and cattle; explain how structure supports species-specific roles (flight, endurance, companionship, meat production).
2. Use handheld sensors or a free smartphone app to monitor rumen pH, heart-rate variability, or body-surface temperature during a feeding or handling session; interpret data to assess stress and health status.
3. Evaluate thermoregulation strategies (sweating, panting, feather fluffing, huddling) and recommend facility or management adjustments for heat- or cold-stress mitigation.
4. Relate endocrine responses (growth, lactation, stress) to seasonal, nutritional, and management cues; diagram feedback loops for one hormone system.
5. Present a case study that links an anatomical/physiological disorder (e.g., bloat, hip dysplasia) to prevention or treatment protocols.

F. The student demonstrates the necessary skills to integrate quantitative genetics and emerging biotechnologies into responsible animal-breeding decisions. The student is expected to:

1. Calculate simple selection indexes combining at least three EPD/EBV traits; justify sire or dam choices that balance production, health, and welfare goals.
2. Analyze teacher-provided SNP or genomic-estimated breeding value (GEBV) data using a templated spreadsheet; summarize how molecular information refines traditional selection.
3. Outline the steps, costs, and success rates for in vitro fertilization (IVF) and embryo transfer (ET); compare to artificial insemination for one livestock species.
4. Debate societal and regulatory perspectives on gene editing vs. transgenics in food-animal, laboratory, and companion-animal contexts; craft a position statement citing current policy.
5. Design a breeding plan for a zoo or conservation program that maximizes genetic diversity using studbook data (simulated if needed).

G. The student demonstrates the necessary skills to optimize rations, feeding systems, and resource use for sustainable animal production. The student is expected to:

1. Balance a finishing-steer ration and a senior-dog maintenance diet with a free web-based ration-formulator; compare predicted performance and cost per unit of gain.
2. Conduct a feed-additive trial (yeast culture, enzyme, or probiotic) on a small animal or class micro-livestock project; record intake, weight gain, and feed-conversion ratio (FCR).
3. Interpret net-energy and amino-acid requirements from extension tables; explain how phase feeding or precision feeding reduces waste nutrients.
4. Calculate water-to-feed ratios for poultry, swine, and dairy; recommend watering-system improvements for hygiene and conservation.
5. Analyze life-cycle assessment (LCA) data for conventional vs. alternative protein systems (e.g., beef, insect, cultured meat) and discuss implications for global food security.

H. The student demonstrates the necessary skills to implement holistic animal-health programs that safeguard animals, people, and the environment. The student is expected to:

1. Construct a written herd/flock health protocol that integrates vaccination, parasite control, biosecurity zoning, and residue-avoidance plans; obtain veterinarian feedback if available.
2. Calculate withdrawal intervals and dosage rates from online drug-label libraries; practice correct administration technique on models or inert materials under PPE guidelines.
3. Diagnose common metabolic or management disorders (ketosis, foot rot, canine obesity) from case descriptions; propose evidence-based treatment and prevention.
4. Apply audit checklists (e.g., Beef Quality Assurance, UEP Cage-Free) to evaluate welfare compliance in a local or virtual facility; suggest two cost-effective improvements.
5. Explain zoonotic-disease pathways (rabies, salmonellosis, influenza) and develop a public-education infographic for peers or community audiences.

I. The student demonstrates the necessary skills to connect real-time production data to product quality, economics, and consumer demand. The student is expected to:

1. Identify key performance indicators (KPIs) for beef, dairy, pork, broiler, egg, aquaculture, and companion-animal enterprises; compare class data to regional benchmarks.
2. Grade carcass or egg-quality images with free virtual tools; correlate live-animal management decisions (nutrition, genetics, handling) to product outcomes.
3. Use current market reports to compute breakeven prices, gross margins, or cost-of-production for one enterprise; discuss risk-management options (hedging, insurance).
4. Evaluate value-added labeling programs (organic, grass-fed, cage-free, certified humane) for compliance costs, consumer perception, and price premiums.
5. Draft a simplified business plan or pitch deck for a student-run animal enterprise or SAE, including projected budgets and marketing strategy.

J. The student demonstrates the necessary skills to synthesize animal-science knowledge through inquiry, professional documentation, and leadership activities. The student is expected to:

1. Design and carry out an independent or team research project aligned to any standard above; collect and analyze data with spreadsheet-based statistics (t-test, simple regression).
2. Prepare either (a) a full scientific poster or (b) a concise three-slide video presentation summarizing the project; deliver findings at an FFA Agriscience Fair, local symposium, or virtual conference.
3. Compile a digital portfolio that includes the Elanco certification credential, SAE records, project abstracts, facility audits, and a reflective essay mapped to ANSC 101 learning outcomes.
4. Conduct an informational interview with a professional in one animal-science career (veterinary tech, feed-sales, lab-animal care, zoo keeper, researcher); summarize required education, certifications, and emerging skills.
5. Create a post-secondary plan highlighting dual-enrollment options, scholarship opportunities, and experiential-learning programs (internships, undergraduate research) in animal science or related majors.

Course Standards: Agriculture Animal Science IV (Veterinary Medicine)

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 & Technical Education Program of Study begins with Agriculture Science I, a common foundations course covering plant and animal biology, soils, water, and sustainable food systems. From there, districts may offer one or both two-course pathways: Crop Science II–III, which prepares students for the BASF Plant Science certification while using drone and satellite imagery in labs that align with both the University of Maryland’s PLSC 112 Introductory Crop Science and the University of Maryland Eastern Shore’s PLSC 184 Introduction to Plant Science; and Animal Science II–III, which culminates in the Elanco Fundamentals of Animal Science credential and capstone projects that map to UMD’s ANSC 101 Principles of Animal Science as well as UMES’s ANPT 114 Introduction to Animal Science. The Animal Science pathway also lays the academic and clinical groundwork for an optional fourth-level Veterinary Medicine IV course, enabling students to pursue the Elanco Veterinary Medicine certification.
 - D. In Agriculture Animal Science VI (Veterinary Medicine): Students capture and annotate digital radiographs, maintain electronic medical records in practice-management software, and develop client-communication competencies through role-play and telehealth scenarios. A required externship or supervised in-school clinic rounds culminates in a documented skills log, capstone presentation, and a digital portfolio that positions graduates for immediate employment as veterinary assistants or seamless transition into collegiate veterinary technology and animal-science programs.
 - 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 veterinary science and veterinary medicine.
2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in veterinary science and veterinary medicine.

C. The student develops technology and digital literacy skills. The student is expected to:

1. Navigate veterinary practice-management software to schedule appointments, enter SOAP notes, and generate itemized estimates or invoices while maintaining accurate electronic medical records.
2. Capture, annotate, and store digital radiographs or ultrasound images in DICOM or cloud folders, applying secure file-naming conventions and data-privacy protocols.
3. Consult reputable online drug formularies and withdrawal-time databases; use built-in dosage calculators to verify medication amounts and document them in a digital treatment log.
4. Employ telemedicine or secure video-conferencing tools to relay patient data and images to supervising veterinarians, demonstrating awareness of client confidentiality and cybersecurity best practices.
5. Integrate point-of-care sensor apps, spreadsheet functions, and basic statistical tools to graph trends in vital signs, lab results, or herd-health metrics for evidence-based decision-making.

D. The student integrates core academic skills into veterinary practices. The student is expected to:

1. Apply algebraic reasoning and proportional relationships to calculate medication dosages, fluid-rate adjustments, and solution dilutions for multiple species and life stages.
2. Design and carry out controlled investigations—such as comparing wound-healing treatments—by formulating hypotheses, collecting quantitative and qualitative data, and interpreting results with basic statistical tools (mean, range, t-test).
3. Read, interpret, and synthesize complex technical texts, including peer-reviewed articles, drug formularies, diagnostic lab reports, and state veterinary regulations, to support evidence-based clinical decisions.

4. Produce clear, organized clinical documents—SOAP notes, discharge instructions, and client-education handouts—using appropriate medical terminology, standard abbreviations, and citation formats.
5. Deliver effective oral and multimedia presentations that explain case studies or research findings to both professional and lay audiences, employing visual aids (charts, radiograph images, infographics) to enhance comprehension.

E. The student demonstrates the necessary skills to maintain a safe, compliant veterinary environment.

1. Identify and correctly use PPE, sharps-disposal systems, and sterilization equipment (autoclave or cold sterilant) for routine clinic tasks.
2. Summarize Maryland veterinary-practice regulations and explain the scope of duties allowed for veterinary assistants vs. technicians vs. DVMs.
3. Create a biosecurity and zoonosis-prevention checklist for companion, food, and lab-animal housing areas.
4. Perform a hazard walk-through, labeling OSHA physical, chemical, and biological hazards; recommend mitigation measures.
5. Document emergency procedures for fire, anesthesia spill, animal escape, aggressive patient, and data breach scenarios.

F. The student demonstrates the necessary skills to apply integrative A&P knowledge to patient assessment.

1. Locate major skeletal landmarks, venipuncture sites, and injection triangles on canine, feline, bovine, and avian mannequins or live demonstrations.
2. Collect baseline TPR (temperature, pulse, respiration) data on at least two species; chart deviations and relate findings to potential disorders.
3. Explain basic organ-system pathophysiology for common clinical presentations (e.g., canine parvovirus, bovine mastitis, avian respiratory disease).
4. Describe developmental differences—neonate, juvenile, adult, geriatric—that affect drug dosages and nursing protocols.

G. The student demonstrates the necessary skills to assist with routine veterinary diagnostics.

1. Prepare blood smears and fecal floats; identify erythrocytes, leukocytes, parasites, and note abnormal morphology.
2. Read and record results from SNAP® or similar rapid tests (heartworm, parvo, FeLV/FIV), explaining test principles and false-positive risks.
3. Position and restrain a canine or feline mannequin for lateral and ventrodorsal radiographs; practice safe radiation PPE protocols using a teaching X-ray simulator or digital demo software.
4. Calibrate and use a glucometer and refractometer; interpret values in the context of species-specific reference ranges.
5. Complete a mock laboratory request form and chain-of-custody log for an outside diagnostic lab.

H. The student demonstrates the necessary skills to support veterinarians in basic medical and surgical care.

1. Calculate drug dosages from label directions; draw up simulated intramuscular, subcutaneous, and intravenous injections using oranges, silicon pads, or task trainers.
2. Perform aseptic scrub and gowning/gloving procedures for surgical prep; maintain a sterile field during a simulated spay or suture lab.
3. Demonstrate common restraint methods (lateral, sternal, standing) for dogs, cats, rabbits, and small ruminants to facilitate safe treatment.

4. Assemble and troubleshoot anesthesia circuits; monitor simulated vital signs and adjust vaporizer settings in a computer-based simulator.
5. Explain post-operative care requirements (analgesia, nutrition, wound monitoring) and draft a discharge instruction sheet for owners.

I. The student demonstrates the necessary skills to interact professionally with clients and maintain accurate medical records.

1. Role-play reception encounters, intake history taking, and client education conversations using clear, empathetic language.
2. Enter SOAP (Subjective, Objective, Assessment, Plan) notes into sample veterinary practice-management software or a cloud-based template.
3. Generate an estimate and invoice for preventive care vs. surgical procedures; explain line items to a mock client.
4. Discuss confidentiality, informed consent, and data-privacy rules (e.g., HIPAA-like expectations in vet medicine).
5. Compare inventory-control methods for pharmaceuticals, biologics, and consumables; calculate reorder points and cost of goods sold.

J. The student demonstrates the necessary skills to synthesize veterinary knowledge through supervised practice and career preparation.

1. Complete a minimum of 40 in-school clinical-skill hours (simulation labs) plus 60 externship hours at a partner clinic, shelter, or research facility (adjustable based on district resources).
2. Maintain a skill log documenting restraint, laboratory, surgical-assist, and client-service tasks; obtain mentor sign-offs for each competency.
3. Prepare for and attempt the Elanco Veterinary Medicine certification exam (or practice exam if the credential is still in pilot).
4. Assemble a digital portfolio that includes certification results, externship evaluations, case study reflections, and a résumé tailored to veterinary assistant positions.
5. Outline post-secondary pathways—CVA/AVA, A.A.S. Vet Tech, B.S. Animal Science, D.V.M.—identifying prerequisite courses, tuition estimates, and scholarship options.