CASE

Introduction to Food, Natural Resources, and Agriculture Expanded Lesson Review

The following is a complied listing of the concepts, performance objectives, standards alignments, and essential questions by lesson.

Lesson 1.1 Agriculture Everyday

Concepts	Performance Objectives
Students will know and understand	Students will learn concepts by doing
1. Agriculture and natural resource systems provide the three basic human needs of food, clothing, and shelter.	• Determine if their basic needs are met after simulating the collection of resources during different situations. (Activity 1.1.1)
2. Organization and record keeping are important to the success of an agricultural business.	• Develop and keep an Agriscience Notebook to record and store information. (Activity 1.1.2)
3. Agriculture is a broad field of study that includes agriculture systems, natural resource management, science, business, communication, and leadership.	• Interpret types of activities associated with agriculture from a case study about an agricultural entrepreneur. (Activity 1.1.3)
4. Production of agricultural commodities occurs within specific regions of the United States.	• Research top commodities produced in the United States and determine costs of food to consumers. (Activity 1.1.4)

National AFNR Common Career Technical Core Standards Alignment

Agriculture, Food, and Natural Resources Career Cluster
2. Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role agriculture, food and natural resources (AFNR) play in society and the economy.
• AG 2.2: Examine the role of AFNR in global, national, and regional economies.
• AG 2.3: Explain the types of industries, organizations, and activities part of AFNR.
• AG 2.4: Explain the influence of AFNR on society.
6. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
• AG.6.1: Explain foundational cycles and systems of AFNR.
• AG.6.2: Explain the interconnectedness of systems within AFNR.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Earth and Space Science	
ESS3: Earth and Human Activity	
ESS3.A: Natural Resources	• Resource availability has guided the development of human society.

Science and Engineering Practices	
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Crosscutting Concepts	
Cause and Effect: Mechanism and Prediction	Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	• Changes in systems may have various causes that may not have equal effects.

Understandings about the Nature of Science	
Science is a Human Endeavor	• Technological advances have influenced the progress of science and science has influenced advances in technology.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Integration of Knowledge and Ideas	• **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What is agriculture?
2. What are basic human needs?
3. How has agriculture made life easier?
4. What industries are related to agriculture?
5. What is a commodity?
6. What agricultural products are produced in the United States?
7. What crops and animals are predominantly grown in each region of the United States?
8. What crops and animals are typically produced in my state?
9. How much does food cost in the United States compared to other countries?

Lesson 1.2 Preparing for Your Future

Concepts	Performance Objectives
Students will know and understand 1. Employability skills, such as work ethic, timeliness, communication, and self-direction, are essential attributes for a successful career.	*Students will learn concepts by doing* • Develop and maintain a career portfolio following a specific format. (Project 1.2.1)

2. Agriculture is a broad field that encompasses many employment areas and offers a wide array of career opportunities.	• Investigate the career opportunities available in agriculture. (Activity 1.2.2) • Classify careers according to categories in agriculture. (Activity 1.2.2) • Evaluate personal interests related to career pathways. (Activity 1.2.2)
3. Supervised Agricultural Experiences (SAE) programs provide opportunities to explore potential career choices and develop professional career goals.	• Complete an exploratory Supervised Agricultural Experience. (Activity 1.2.3)
4. The National FFA Organization offers members many opportunities to build necessary employment and life skills, such as leadership, personal character, and career options.	• Select FFA educational and personal growth opportunities meeting career interests. (Activity 1.2.4)
5. Career Development Events (CDE) expose students to numerous opportunities for academic application in agriculture.	• Complete components of ten Career Development Events. (Activity 1.2.5)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
1. Act as a responsible and contributing citizen and employee.
• CRP.01.03: Identify and act upon opportunities for professional and civic service at work and in the community.
2. Apply appropriate academic and technical skills.
• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
10. Plan education and career path aligned to personal goals.
• CRP.10.01: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.
• CRP.10.02: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.
• CRP.10.03: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.
• CRP.10.04: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.
Agriculture, Food, and Natural Resources Career Cluster
5. Describe career opportunities and means to achieve those opportunities in each of the AFNR career pathways.
• AG.5.1: Locate and identify career opportunities that appeal to personal career goals.
• AG.5.2: Match personal interest and aptitudes to selected careers.
• AG.5.3: Provide examples and descriptions of various careers in each of the AFNR pathways.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What is the difference between a job and a career?
2. What career opportunities are available in agriculture and natural resources?
3. What is a career portfolio?

4. How will a career portfolio benefit me?
5. How can I use my interests to help select a career?
6. What careers best fit my skills?
7. How can I start a Supervised Agricultural Experience (SAE) program?
8. What are the benefits of a SAE?
9. What type of SAE program is right for me?
10. Why is it important to start planning my career path now?
11. What is the National FFA Organization?
12. Why should I join FFA?
13. How is FFA important to agricultural education?
14. What are Career Development Events?
15. How will Career Development Events help me develop skills for a future career?

Lesson 2.1 Listen to Me

Concepts	Performance Objectives
Students will know and understand	Students will learn concepts by doing
1. People utilize multiple forms of verbal and nonverbal communication.	• Demonstrate verbal and non-verbal forms of communication in a charades-like game. (Activity 2.1.1) • Identify and select appropriate attire for different activities. (Activity 2.1.2) • Prepare a formal introduction. (Activity 2.1.3)
2. Voice, presence, and expression are used in communicating effectively.	• Present a formal introduction. (Activity 2.1.3) • Practice effective public speaking characteristics. (Activity 2.1.4)
3. Speeches may be informative, persuasive, or special occasion.	• Develop and present an informative speech. (Activity 2.1.4)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
4. Communicate clearly, effectively and with reason.
• CRP.04.01: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
• CRP.04.03: Model active listening strategies when interacting with others in formal and informal settings.
9. Model integrity, ethical leadership and effective management.
• CRP.09.01: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).
• CRP.09.02: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).
• CRP.09.03: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

Common Core State Standards – English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. • **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.5 –** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. How do people communicate?
2. What is non-verbal communication?
3. Why is having a firm handshake important?
4. What message does my clothing send to others?
5. How does clothing non-verbally communicate to others?
6. How do I introduce myself to other people?
7. How do I initiate a conversation?
8. How do I make a formal introduction of another person?
9. What are characteristics of a good speaker?
10. How do I write and prepare a speech?

Lesson 2.2 Let's Get Together

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. People utilize multiple forms of communication in their daily lives.	• Work collaboratively to complete team building challenges. (Activity 2.2.1)
2. Parliamentary procedures are used to conduct orderly meetings.	• Use proper parliamentary procedures to voice an opinion. (Activity 2.2.2) • Demonstrate the proper procedures for making a main motion and an amendment. (Activity 2.2.2)

3. Teamwork is essential when solving many problems and completing group tasks.	• Use group norming and teamwork skills while working in a group. (Project 2.2.3)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
1. Act as a responsible and contributing citizen and employee.
• CRP.01.03: Identify and act upon opportunities for professional and civic service at work and in the community.
4. Communicate clearly, effectively and with reason.
• CRP.04.01: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
9. Model integrity, ethical leadership and effective management.
• CRP.09.01: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).
• CRP.09.03: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).
12. Work productively in teams while using cultural/global competence.
• CRP.12.01: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.
• CRP.12.02: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
Production and Distribution of Writing	• **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. Why is it important to be able to communicate effectively with others?
2. How are parliamentary procedures used to maintain order?
3. Why is the use of parliamentary procedures beneficial when working in groups?
4. What are the steps to making a motion?
5. What is a majority?
6. What is a main motion?
7. How do I make an amendment to a main motion?

8. What does it take to be a good group or team member?
9. How do I work with others to give a good team presentation?
10. How do I work with others to establish group expectations or norms?
11. How should a group handle conflict?

Lesson 3.1 Agriscience Safety and Measurement

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Laboratory equipment has specific uses in scientific experiments.	• Identify and describe the uses of common laboratory equipment. (Activity 3.1.1) • Use equipment to collect data for an experiment. (Activity 3.1.1)
2. Emergency equipment is available and has specific uses.	• Locate and determine the purpose of emergency equipment items located in the classroom, laboratory, and shop facilities. (Activity 3.1.2)
3. Understanding and following procedures and rules are essential to maintaining a safe work environment.	• Work with their classmates to develop a list of ten safety rules to follow. (Activity 3.1.3)
4. Reading and understanding laboratory procedures are essential to conducting a laboratory experiment safely.	• Follow written procedures to complete a laboratory exercise. (Activity 3.1.4)
5. Mass, volume, temperature, and density are common laboratory measurements.	• Measure distance, volume, mass, temperature, and density using the appropriate tools and scale. (Activity 3.1.4)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
3. Attend to personal health and financial well-being.
• CRP.03.01: Design and implement a personal wellness plan.
4. Communicate clearly, effectively and with reason.
• CRP.04.01: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
11. Use technology to enhance productivity.
• CRP.11.01: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.
12. Work productively in teams while using cultural/global competence.
• CRP.12.02: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).
Agriculture, Food, and Natural Resources Career Cluster
3. Examine and summarize importance of health, safety, and environmental management systems in AFNR organizations.

• AG 3.1: Examine health risks associated with a particular skill to better form personnel safety guidelines.
• AG 3.4: Examine required regulations to maintain/improve safety, health and environmental management systems and sustainable business practices.
• AG.3.7: Demonstrate application of personal and group health and safety practices.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Select appropriate tools to collect, record, analyze, and evaluate data.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Crosscutting Concepts	
Cause and Effect: Mechanism and Prediction	Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Understandings about the Nature of Science	
Scientific Investigations Use a Variety of Methods	• Science investigations use diverse methods and do not always use the same set of procedures to obtain data. • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	• Scientists often use hypotheses to develop and test theories and explanations.
Science is a Way of Knowing	• Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.
Science is a Human Endeavor	• Scientific knowledge is a result of human endeavor, imagination, and creativity.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.
CCSS: Conceptual Category – Statistics and Probability	
Interpreting Categorical and Quantitative Data	*Summarize, represent, and interpret data on a single count or measurement variable.
Making Inferences and Justifying Conclusions	*Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. Why is science important to agriculture?
2. What tools and equipment are commonly used in the laboratory?
3. What rules and procedures limit accidents in a laboratory setting?
4. Why are laboratory and shop areas color-coded?
5. How do you measure distance, volume, mass, temperature, and density?

Lesson 3.2 Agriscience Investigators

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Classification of people, places, and things is a basic skill used in daily life, scientific research, and the agricultural industry.	• Classify objects based on their physical characteristics. (Activity 3.2.1) • Categorize animals using physical characteristics. (Activity 3.2.1)
2. Proper and accurate data measurement and analysis is important for laboratory investigation.	• Use a LabQuest2 and temperature sensor to collect data for an experiment. (Activity 3.2.2)
3. The pH scale is 0-14 where 0 is extremely acidic, 7 is neutral, and 14 is extremely basic.	• Determine if a substance is an acid or a base using LabQuest2® and a pH sensor. (Activity 3.2.3)
4. Scientific method is a systematic process used to solve a problem.	• Use a minimum of four science processes to design an experiment. (Project 3.2.4) • Perform a skit to demonstrate the science processes used in the experiment, laboratory safety, and group communication skills. (Project 3.2.4)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
4. Communicate clearly, effectively and with reason.
• CRP.04.01: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

11. Use technology to enhance productivity.
• CRP.11.01: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
3. Examine and summarize importance of health, safety, and environmental management systems in AFNR organizations.
• AG.3.7: Demonstrate application of personal and group health and safety practices.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Select appropriate tools to collect, record, analyze, and evaluate data.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Crosscutting Concepts	
Cause and Effect: Mechanism and Prediction	Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Understandings about the Nature of Science	
Scientific Investigations Use a Variety of Methods	• Science investigations use diverse methods and do not always use the same set of procedures to obtain data. • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	• Scientists often use hypotheses to develop and test theories and explanations.
Science is a Way of Knowing	• Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.
Science is a Human Endeavor	• Scientific knowledge is a result of human endeavor, imagination, and creativity.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Algebra

Seeing Structure in Expressions	*Write expressions in equivalent forms to solve problems.
Arithmetic with Polynomials and Rational Expressions	Perform arithmetic operations on polynomials.

CCSS: Conceptual Category – Statistics and Probability	
Interpreting Categorical and Quantitative Data	*Summarize, represent, and interpret data on a single count or measurement variable.
Making Inferences and Justifying Conclusions	*Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. How do you classify objects?
2. How can several classification categories be used to describe one object?
3. What types of data can be collected?
4. How can I use LabQuest2 to collect data?
5. What is pH?
6. How are acids and bases different?
7. What does the pH scale represent?
8. What are science process skills?
9. How are scientific processes used to solve problems?
10. How does data prove or disprove a hypothesis?

Lesson 4.1 Starting from the Ground Up

Concepts	**Performance Objectives**
Students will know and understand 1. Mineral matter, air, water, and organic matter are found in different proportions within a soil and define soil quality.	*Students will learn concepts by doing* • Conduct a sediment test to determine the particle sizes of the mineral matter and the presence of organic matter in a sample of soil. (Activity 4.1.1)
2. Geographical features and environmental factors influence the formation process of soils and impact soil quality.	• Investigate the effects organic matter has on soil porosity and soil air holding capacity. (Activity 4.1.2)

	• Observe how slope of the land causes water to erode away soil. (Activity 4.1.3)
3. Soil erosion results in the loss of quality top soil and is a concern in the study of mineral soils.	• Conduct an investigation of soil deposition caused by water. (Activity 4.1.3)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
5. Consider the environmental, social and economic impacts of decisions.
• CRP.05.01: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.
• CRP.05.02: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.
Agriculture, Food, and Natural Resources Career Cluster
4. Demonstrate stewardship of natural resources in AFNR activities.
• AG.4.1: Demonstrate evidence of interest and concern for natural resource stewardship.
6. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
• AG.6.2: Explain the interconnectedness of systems within AFNR.
Natural Resource Systems (AG-NR)
1. Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.
• AG-NR 1.2: Apply cartographic skills to the planning, implementing, and evaluating natural resource activities.
2. Plan and Analyze interrelationships between natural resources and humans needed to manage natural resource systems.
• AG-NR 2.1: Examine natural resource topics using science concepts, processes, and research techniques.
• AG-NR 2.2: Examine biological and physical characteristics to identify and classify natural resources.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from careful observation of phenomena, or unexpected results · to clarify and/or seek additional information. · that arise from examining models or a theory, to clarify and/or seek additional information and relationships. · to determine relationships, including quantitative relationships, between independent and dependent variables.
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Crosscutting Concepts	
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Essential Questions

1. What is soil?
2. How are soils formed?
3. What is in soil?
4. How are different colors of soil formed?
5. What is parent material?
6. How old are soils?
7. What is a mineral soil?
8. How do sand, silt, and clay differ?
9. What influences the formation of soil?
10. What is a soil profile?
11. What is important to know about soil layers?
12. What is soil erosion and why is it important to understand?

Lesson 4.2 The Whole Soil

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Sand, silt, and clay are three sizes of mineral particles that comprise soil texture.	• Conduct tests to determine soil texture by feel. (Activity 4.2.1)
2. Soil structure and soil texture are elements that affect soil function.	• Test soil permeability to understand the relationship between soil particle size and rate of water filtration. (Activity 4.2.2)
3. The pH of a soil is affected by its buffering capacity.	• Design an experiment to test the buffering capacity of different soil textures. (Project 4.2.3)
4. The texture, structure, and color of each layer of soil within a profile are used to identify specific horizons.	• Determine the texture, structure, and color of each horizon within a soil profile. (Activity 4.2.4)
5. Soils form in layers that have distinguishing characteristics from other layers in a soil profile.	

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.

• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
4. Communicate clearly, effectively and with reason.
• CRP.04.01: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
• CRP.08.02: Investigate, prioritize and select solutions to solve problems in the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
4. Demonstrate stewardship of natural resources in AFNR activities.
• AG.4.1: Demonstrate evidence of interest and concern for natural resource stewardship.
• AG.4.2: Explain the environmental considerations of decision making in AFNR management.
Plant Systems (AG-PL)
1. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
• AG-PL 1.2: Evaluate soil/media nutrients using tests of appropriate materials and/or by examining data.
• AG-PL 1.5: Manage characteristics of growing media.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from careful observation of phenomena, or unexpected results · to clarify and/or seek additional information. · that arise from examining models or a theory, to clarify and/or seek additional information and relationships. · to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Crosscutting Concepts	
Patterns	Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
	• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Common Core State Standards for High School Mathematics

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. • **WHST.9-10.2.E –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. • **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are the size comparisons among the three soil particles?
2. What do sand, silt, and clay each contribute to soil characteristics?
3. How are sand, silt, and clay detected in a soil sample?
4. What constitutes a loam soil?
5. What is permeability as it pertains to soils and why is it important?
6. What factors affect the pH of soil?
7. What is buffering capacity?
8. Why do certain types of soil structure formations indicate soil quality?
9. How are horizon layers identified?

Lesson 4.3 Water World

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. The water cycle is an example of a naturally occurring system in which the substance can change form and location.	• Play a game to simulate the journey of a drop of water through the water cycle. (Project 4.3.1) • Write and illustrate a story about what they learned regarding the journey a drop of water takes through the water cycle. (Project 4.3.1)
2. Land topography influences the distribution of water and pollutants.	• Conduct an experiment that models the flow of water over a landform. (Activity 4.3.2)
3. Water pollution is caused by point and non-point sources.	• Determine the spread of pollution from point and nonpoint sources. (Activity 4.3.3)
4. The quality of water sources, such as streams and drinking water, can be determined by measuring factors such as temperature, pH, turbidity, dissolved oxygen, and total dissolved solids.	• Perform tests to determine water quality using the factors of temperature, pH, turbidity, dissolved oxygen, and total dissolved solids. (Activity 4.4.3) • Design an experiment determining the quality of drinking water and conduct the experiment to determine its validity. (Project 4.3.5) • Write a lab report regarding their experimental findings. (Project 4.3.5)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
3. Attend to personal health and financial well-being.
• CRP.03.01: Design and implement a personal wellness plan.
• CRP.03.02: Design and implement a personal financial management plan.
5. Consider the environmental, social and economic impacts of decisions.
• CRP.05.02: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
• CRP.08.02: Investigate, prioritize and select solutions to solve problems in the workplace and community.
11. Use technology to enhance productivity.
• CRP.11.01: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

Agriculture, Food, and Natural Resources Career Cluster
1. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
• AG 1.2: Describe current issues impacting AFNR activities.
4. Demonstrate stewardship of natural resources in AFNR activities.
• AG.4.1: Demonstrate evidence of interest and concern for natural resource stewardship.
• AG.4.2: Explain the environmental considerations of decision making in AFNR management.
6. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
• AG.6.1: Explain foundational cycles and systems of AFNR.
• AG.6.2: Explain the interconnectedness of systems within AFNR.
Natural Resource Systems (AG-NR)
1. Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.
• AG-NR 1.2: Apply cartographic skills to the planning, implementing, and evaluating natural resource activities.
• AG-NR 1.3: Obtain and analyze data by monitoring natural resource status.
2. Plan and Analyze interrelationships between natural resources and humans needed to manage natural resource systems.
• AG-NR 2.1: Examine natural resource topics using science concepts, processes, and research techniques.
• AG-NR 2.4: Examine natural cycles and related phenomena to describe ecologic concepts and principles.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Earth and Space Science	
ESS2: Earth's Systems	
ESS2.C: The Roles of Water in Earth's Surface Processes	• The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.
ESS3: Earth and Human Activity	
ESS3.A: Natural Resources	• Resource availability has guided the development of human society.
ESS3.C: Human Impacts on Earth Systems	• The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. • Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable

	measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
	• Select appropriate tools to collect, record, analyze, and evaluate data.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Range of Reading and Level of Text Complexity	• **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.9-10.2.B –** Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. • **WHST.9-10.2.C –** Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. • **WHST.9-10.2.D –** Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. • **WHST.9-10.2.E –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. • **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.5 –** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What is the water cycle?
2. Where is water found?
3. What forms does water take throughout the water cycle?
4. How does topography influence the flow of water?
5. What is pollution?
6. What causes pollution?
7. What is point source pollution?
8. What is nonpoint source pollution?
9. How do point source and non-point source pollution differ?
10. How does slope of the land affect the spread of contaminants?
11. What indicators can be used to measure water quality?
12. How do temperature, pH, turbidity, dissolved oxygen, and total dissolved solids affect water?
13. How do the indicators used to determine water quality for drinking water differ from those used to determine the water quality of streams?

Lesson 4.4 Living in Harmony

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Energy flows from producers (plants) to consumers (animals).	• Simulate the flow of energy in an ecosystem. (Activity 4.4.1)
2. Plants and animals depend on each other for survival.	• Conduct an experiment to determine the interdependence of plants and animals. (Activity 4.4.2)
3. Ecosystems are an interaction between organisms and the environment in which the organisms live.	• Complete a WebQuest researching an ecosystem. (Project 4.4.3) • Develop a model and poster depicting the ecosystem they studied. (Project 4.4.3) • Record key points of ecosystems presented by classmates. (Activity 4.4.4)

National AFNR Common Career Technical Core Standards Alignment

Agriculture, Food, and Natural Resources Career Cluster
6. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
• AG.6.1: Explain foundational cycles and systems of AFNR.
• AG.6.2: Explain the interconnectedness of systems within AFNR.
Natural Resource Systems (AG-NR)
2. Plan and Analyze interrelationships between natural resources and humans needed to manage natural resource systems.
• AG-NR 2.3: Examine natural cycles and related phenomena to describe ecologic concepts and principles.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Life Science	
LS1: From Molecules to Organisms: Structures and Processes	
LS1.C: Organization for Matter and Energy Flow in Organisms	• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
LS2: Ecosystems: Interactions, Energy, and Dynamics	
LS2.A: Interdependent Relationships in Ecosystems	• Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	• Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
LS2.C: Ecosystem Dynamics, Functioning, and Resilience	• A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from careful observation of phenomena, or unexpected results · that arise from examining models or a theory, to clarify and/or seek additional information and relationships. · to determine relationships, including quantitative relationships, between independent and dependent variables.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Crosscutting Concepts	
Patterns	Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
	• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
Cause and Effect: Mechanism and Prediction	Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Scale, Proportion, and Quantity	In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
	• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. • Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. • Patterns observable at one scale may not be observable or exist at other scales. • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Energy and Matter: Flows, Cycles, and Conservation	Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
	• The total amount of energy and matter in closed systems is conserved. • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
Stability and Change	For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
	• Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Algebra	
Seeing Structure in Expressions	*Interpret the structure of expressions. *Write expressions in equivalent forms to solve problems.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.1 –** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. • **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Integration of Knowledge and Ideas	• **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What is ecology?
2. What is energy?
3. What is the difference between a biome and an ecosystem?
4. How are producers and consumers different?
5. How is energy lost in transfers through the energy pyramid?
6. What is a food web?
7. How do plants and animals depend on each other for gas exchange?
8. What are environmental characteristics of an ecosystem?
9. What types of plants and animals live in an ecosystem?
10. How are organisms in an ecosystem influenced by humans?
11. How do ecosystems differ across the United States?

Lesson 5.1 Totally Cellular

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Animal and plant cells have many similarities, especially in regards to cell function; however, there are important structural differences between the two cell types.	• Identify and label the parts of a cell including each cell organelle function. (Activity 5.1.1) • Determine structural differences between an animal and plant cell. (Activity 5.1.1)
2. The nucleus of an animal and a plant cell is important for several life sustaining processes, such as cell division and protein synthesis.	• Describe the structure and function of a cell's nucleus. (Activity 5.1.1)
3. Microscopes are used to examine cells and cellular features.	• Demonstrate the correct use of a microscope and prepare a microscope slide to identify the nucleus of an onion cell. (Activity 5.1.2)
4. DNA is genetic material that combined with protein comprises the chromosomes found inside animal and plant cell nuclei.	• Extract the DNA bundles from strawberry tissue for observation. (Activity 5.1.3) • Construct a DNA model and demonstrate how DNA replication happens in a cell. (Activity 5.1.4)
5. Genes are a combination of DNA segments that define animal and plant physical appearance.	• Identify differences in physical features of people and trace their family traits. (Activity 5.1.5)
6. Offspring of animals and plants derive their genetic traits from both parents.	• Identify similarities in characteristics to trace family traits. (Project 5.1.6) • Use concept mapping software to organize thoughts. (Project 5.1.6)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
6. Demonstrate creativity and innovation.
• CRP.06.01: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
6. Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
• AG.6.1: Explain foundational cycles and systems of AFNR.
Animal Systems Career Pathway (AG-ANI)
6. Classify, evaluate and select animals based on anatomical and physiological characteristics.
• AG-ANI 6.2: Describe basic functions of animal cells, organs, and systems.
Biotechnology Systems Career Pathway Content Standards
BS.02: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).
• BS.02.05: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Life Science	
LS1: From Molecules to Organisms: Structures and Processes	
LS1.A: Structure and Function	• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
LS3: Heredity: Inheritance and Variation of Traits	
LS3.A: Inheritance of Traits	• Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.
LS3.B: Variation of Traits	• In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Crosscutting Concepts	
Systems and System Models	• A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
	• Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Structure and Function	• The way an object is shaped or structured determines many of its properties and functions.
	• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Understandings about the Nature of Science	
Science is a Way of Knowing	• Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.
Scientific Knowledge Assumes an Order and Consistency in Natural Systems	• Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Craft and Structure	• **RST.9-10.4 –** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What is a cell?
2. How are animal and plant cells similar?
3. What different physical structures do animal and plant cells contain?
4. What does the nucleus look like in terms of appearance?
5. What is important about the nucleus of animal and plant cells?
6. What is DNA?
7. Why is DNA important for the development of animals and plants?
8. What are genes?
9. How are genes associated with DNA?
10. Why is an understanding of genes important for animal and plant production?

Lesson 5.2 All About Plants

Concepts	**Performance Objectives**
Students will know and understand 1. Plants have roots, stems, leaves, and flowers, which are all vital to survival.	*Students will learn concepts by doing* • Identify and sketch the four basic plant parts. (Activity 5.2.1) • Describe the functions of plant parts. (Activity 5.2.1)

2. Flowers, consisting of four main parts, produce seeds for reproduction.	• Construct a model depicting the parts of a complete flower. (Project 5.2.2)
3. Seeds require moisture and warmth for germination.	• Conduct a germination trial to determine the germination rate of bean seeds. (Activity 5.2.3)
4. Plants convert raw materials using the energy of the sun into sugar and oxygen.	• Determine the presence of starch in plants that have received different light treatments. (Activity 5.2.4)
5. Plant cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water.	• Collect data on the rate of respiration and photosynthesis of plant leaves. (Activity 5.2.5)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
3. Examine and summarize importance of health, safety, and environmental management systems in AFNR organizations.
• AG 3.5: Enact procedures that demonstrate the importance of safety, health, and environmental responsibilities in the workplace.
• AG.3.7: Demonstrate application of personal and group health and safety practices.
Plant Systems (AG-PL)
2. Apply principles of classification, plant anatomy, and plant physiology to plant production and management.
• AG-PL 2.1: Examine unique plant properties to identify/describe functional differences in plant structures including roots, stems, flowers, leaves, and fruit.
• AG-PL 2.3: Apply knowledge of plant anatomy and plant structures to plant systems activities.
3. Propagate, culture, and harvest plants and plant products based on current industry standards.
• AG-PL 3.7: Demonstrate plant propagation techniques.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Life Science	
LS1: From Molecules to Organisms: Structures and Processes	
LS1.C: Organization for Matter and Energy Flow in Organisms	• The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)

Crosscutting Concepts	
Structure and Function	• The way an object is shaped or structured determines many of its properties and functions.
	• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Algebra	
Seeing Structure in Expressions	*Write expressions in equivalent forms to solve problems.

CCSS: Conceptual Category – Statistics and Probability	
Making Inferences and Justifying Conclusions	*Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Craft and Structure	• **RST.9-10.4 –** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
Range of Reading and Level of Text Complexity	• **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are the four major parts of a plant?
2. What are three functions of each of the four plant parts?
3. What are the parts of a flower?
4. What is a complete flower?
5. How does water affect the germination rate of seeds?
6. How does the sun play a role in the life of a plant?
7. How do plants convert carbon dioxide into oxygen?
8. How do plants convert radiant energy from the sun into available energy?
9. What is the difference between photosynthesis and respiration?

Lesson 5.3 Plant Needs

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Plants require adequate amounts of water for survival, growth, and development.	• Determine the relationship between water availability and turgor pressure. (Activity 5.3.1)

2. Production and management of plants are based upon environmental conditions, such as temperature.	• Calculate growing degree units for two locations to determine crop maturity. (Activity 5.3.2) • Design and conduct an inquiry experiment on one environmental factor to investigate the optimal growth range for a plant. (Project 5.3.5) • Write a lab report and develop a poster to report their findings on environmental conditions and plant growth. (Project 5.3.5)
3. The three primary nutrients, nitrogen, phosphorus, and potassium, are necessary for the healthy growth of plants.	• Research plant macronutrients and record the functions in plants, deficiency symptoms, and sources for each. (Activity 5.3.3)
4. The level of pH affects the health and well-being of plants.	• Conduct an inquiry lab on the effect of pH on plant health. (Activity 5.3.4)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
4. Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
• CRP.08.02: Investigate, prioritize and select solutions to solve problems in the workplace and community.
Plant Systems (AG-PL)
1. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
• AG-PL 1.2: Evaluate soil/media nutrients using tests of appropriate materials and/or by examining data.
• AG-PL 1.3: Determine the influence of environmental factors on plants.
• AG-PL 1.4: Manage water conditions for plant growth.
• AG-PL 1.5: Manage characteristics of growing media.
2. Apply principles of classification, plant anatomy, and plant physiology to plant production and management.
• AG-PL 2.3: Apply knowledge of plant anatomy and plant structures to plant systems activities.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Physical Science	
PS1: Matter and Its Interactions	
PS1.B: Chemical Reactions	• Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions that arise from careful observation of phenomena, or unexpected results · to clarify and/or seek additional information.

	· to determine relationships, including quantitative relationships, between independent and dependent variables.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
Developing and Using Models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
Constructing Explanations and Designing Solutions	Constructing explanations and designing solutions in 9–12 builds on K– 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.
Engaging in Argument from Evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Crosscutting Concepts	
Cause and Effect: Mechanism and Prediction	Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • Systems can be designed to cause a desired effect.

Understandings about the Nature of Science	
Scientific Investigations Use a Variety of Methods	• Science investigations use diverse methods and do not always use the same set of procedures to obtain data. • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.
Science is a Way of Knowing	• Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Statistics and Probability	
Interpreting Categorical and Quantitative Data	*Summarize, represent, and interpret data on two categorical and quantitative variables.
Making Inferences and Justifying Conclusions	*Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Integration of Knowledge and Ideas	• **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
Range of Reading and Level of Text Complexity	• **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.9-10.1.B –** Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. • **WHST.9-10.1.D –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. • **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are the environmental needs of plants?
2. What role does water play in sustaining plant life?
3. How does water help physically support plants?
4. How does temperature affect plant growth and maturity?
5. How can the maturity of plants be predicted using historical climate data?
6. Why are nutrients necessary for plants?
7. What are the essential macronutrients?
8. How are nutrient deficiency symptoms identified?
9. How do acids and bases affect the health of living organisms?
10. How can you determine the optimal pH range for petunias?
11. What are the optimal ranges of environmental conditions for plant growth?

Lesson 5.4 Animals in Ag

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Animals are classified by species, gender, age, and purpose.	• Categorize animals by gender and species. (Activity 5.4.1)
2. Animals have a complex set of systems that must work together.	• Develop a concept map of the internal body systems and their relationships. (Activity 5.4.2)
3. Body parts of animals vary among different species.	• Study and learn the basic anatomical parts of an animal. (Project 5.4.2) • Develop a poster of the external anatomy of an animal that will be used to teach others. (Project 5.4.3)
4. Animals are selected based upon the quality and correctness of anatomical structure and productive potential.	• Make decisions based on given priorities and criteria, and analyze objects as they compare ideal criteria. (Activity 5.4.4) • Evaluate a class of market hogs based on specific priorities. (Activity 5.4.4)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
4. Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
Animal Systems Career Pathway (AG-ANI)
4. Apply principles of animal reproduction given desired outcomes for performance, development and/or economic production.
• AG-ANI 4.1: Evaluate animals for breeding readiness and soundness.
6. Classify, evaluate and select animals based on anatomical and physiological characteristics.
• AG-ANI 6.1: Classify animals by hierarchical taxonomy and use.

• AG-ANI 6.2: Describe basic functions of animal cells, organs and systems.
• AG-ANI 6.3: Explain how the components and systems of animal anatomy and physiology relate to the production and use of animals.
• AG-ANI 6.4: Select animals for specific purposes and maximum performance based on anatomy and physiology.

Next Generation Science Standards Alignment

Crosscutting Concepts	
Patterns	• Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
	• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
Structure and Function	• The way an object is shaped or structured determines many of its properties and functions.
	• The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.2 –** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
Craft and Structure	• **RST.9-10.4** – Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. • **RST.9-10.5 –** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
Integration of Knowledge and Ideas	• **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
Range of Reading and Level of Text Complexity	• **RST.9-10.10 –** By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. Why do we use specific terminology when referring to the gender and species of common domestic animals?
2. What systems function together to maintain life?
3. What organs make up each system?
4. How do animal body systems work together?
5. What are the external parts of animals?
6. How do the external parts of animals differ among species?
7. What is criterion-based selection?
8. How are priorities established?

9. Why are priorities critical for decision-making?
10. What is conformation?
11. How can I use criterion-based selection when evaluating an animal, such as market hogs?

Lesson 5.5 Animal Care

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Animals require food, shelter, and water for survival.	• Research and identify the six essential nutrients and the functions of each. (Activity 5.5.1) • Conduct an experiment to demonstrate the effect of insulation on maintaining body heat. (Activity 5.5.2)
2. The nutrients needed by animals include protein, carbohydrates, fats, vitamins, minerals, and water and are found in many feed sources.	• Research and identify the six essential nutrients and the functions of each. (Activity 5.5.1) • Classify feedstuffs according to their nutrient value. (Activity 5.5.1)
3. Shelter helps animals control body temperature.	• Conduct an experiment to demonstrate the effect of insulation on maintaining body heat. (Activity 5.5.2)
4. Animals perceive potential dangers differently than humans.	• Draw conclusions on the perceptions of stimuli based on observations of optical illusions. (Activity 5.5.3)
5. Production and management of animals are based on anatomical and physiological characteristics.	• Match characteristics of various animals to specialized practices related to animals. (Activity 5.5.4)
6. The production of food, fiber, and fuel sometimes creates ethical dilemmas for producers and consumers.	• Determine ethical options to form an opinion on the use of meat for human consumption and related environmental impact issues. (Problem 5.5.5)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices
4. Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
5. Consider the environmental, social and economic impacts of decisions.
• CRP.05.01: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
1. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
• AG 1.2: Describe current issues impacting AFNR activities.
2. Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role agriculture, food and natural resources (AFNR) play in society and the economy.
• AG 2.4: Explain the influence of AFNR on society.

Animal Systems Career Pathway (AG-ANI)
1. Analyze historic and current trends impacting the animal systems industry.
• AG-ANI 1.1: Explain the variety and scope of managed animal systems in the United States and around the world including: livestock, poultry, aquaculture, companion animals, zoo animals and exotic animals.
• AG-ANI 1.3: Describe trends in the animal systems industry.
3. Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.
• AG-ANI 3.2: Assess whether the nutritional requirements of a given animal are being met by recording performance and comparing feed variations.
5. Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.
AG-ANI 5.2: Describe the effects of environmental conditions on animals.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Developing and Using Models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

Understandings about the Nature of Science	
Science Addresses Questions About the Natural and Material World.	• Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	• *Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Statistics and Probability	
Interpreting Categorical and Quantitative Data	• *Summarize, represent, and interpret data on a single count or measurement variable.
Making Inferences and Justifying Conclusions	• *Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.1 –** Write arguments focused on discipline-specific content. • **WHST.9-10.1.A –** Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. • **WHST.9-10.1.B –** Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. • **WHST.9-10.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.

Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are the basic needs of animals?
2. What is a nutrient?
3. What nutrients do animals need to survive?
4. Which nutrients are present in feedstuffs?
5. How do the nutrient needs of animals compare to the nutrient needs of humans?
6. Why do animals need shelter when they have fur, wool, and hair?
7. How does insulation help maintain body temperature?
8. Why do animals react to stimuli differently than people?
9. How can optical illusions affect my perception?
10. How do management practices used in animal production differ?
11. Why are specialized management practices necessary for different animals?
12. How does meat production use energy?
13. How does meat consumption use energy?
14. What are ethics?
15. What is a dilemma?
16. What are the ethical dilemmas people eating meat might face?

Lesson 5.6 Edible Agriculture

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Food is derived from animal and plant products.	• Document the plant and animal food products consumed in a twenty-four-hour period. (Activity 5.6.1)
2. Food must be produced, transported, processed, and stored in a safe way.	• Conduct an experiment to determine bacterial levels of meat samples when refrigerated, stored at room temperature, and cooked. (Activity 5.6.2) • Research the path a prepared food item takes from production to processing and present their findings to the class. (Project 5.6.3)
3. Food may be contaminated at many points while in route to the consumer.	• Observe and record growth of bacterial cultures. (Activity 5.6.2)

	• Solve a problem related to foodborne illness outbreak. (Problem 5.6.4)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
4. Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
7. Employ valid and reliable research strategies.
• CRP.07.02: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
• CRP.08.01: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
Animal Systems Career Pathway (AG-ANI)
1. Analyze historic and current trends impacting the animal systems industry.
• AG-ANI 1.1: Explain the variety and scope of managed animal systems in the United States and around the world including: livestock, poultry, aquaculture, companion animals, zoo animals and exotic animals.
Biotechnology Systems Career Pathway Content Standards
BS.02: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).
• BS.02.03: Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.
• BS.02.04: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.
Food Products and Processing Systems (AG-FD)
4. Explain the scope of the food industry and the historical and current developments of food product and processing.
• AG-FD 4.1: Explain the participants and their relationships in the food industry.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from careful observation of phenomena, or unexpected results · to clarify and/or seek additional information. · to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Understandings about the Nature of Science	
Scientific Investigations Use a Variety of Methods	• Science investigations use diverse methods and do not always use the same set of procedures to obtain data. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Algebra	
Seeing Structure in Expressions	*Write expressions in equivalent forms to solve problems.
Reasoning with Equations and Inequalities	Understand solving equations as a process of reasoning and explain the reasoning. Solve equations and inequalities in one variable.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Craft and Structure	• **RST.9-10.4 –** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.1 –** Write arguments focused on discipline-specific content. • **WHST.9-10.1.A –** Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. • **WHST.9-10.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.
Production and Distribution of Writing	• **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are the sources of food that I typically consume?
2. Do I tend to eat more plant products or animal products?
3. How do people get ill from food?
4. Why is it important to understand how bacteria and other microorganisms cause foodborne illness?
5. What preventative measures can be taken to prevent foodborne illness?
6. Which preventative measures for preventing foodborne illness are the most effective?
7. How does food get from a producer to a consumer?

Lesson 6.1 Energy in Agriculture

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*

1. Renewable and non-renewable energy sources, such as wind, solar, and biofuels, are currently being used in the United States. 2. Agricultural commodities can be converted to alternative energy sources.	• Develop an educational display describing an energy source and the impact agriculture has on that source. (Project 6.1.1)
3. People depend on consumable forms of energy, such as fuel and electricity, which are used in everyday life.	• Measure electrical power used to power a light and motor. (Activity 6.1.2) • Compare fuel consumption costs for agricultural production. (Activity 6.1.4)
4. The efficiency of energy and the amount of energy produced varies among sources.	• Construct a solar energy system and compare the production of electricity under different light conditions. (Activity 6.1.3) • Compare the energy content of two common fuels used for energy production. (Activity 6.1.5)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
5. Consider the environmental, social and economic impacts of decisions.
• CRP.05.02: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.
7. Employ valid and reliable research strategies.
• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
1. Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
• AG 1.2: Describe current issues impacting AFNR activities.
4. Demonstrate stewardship of natural resources in AFNR activities.
• AG.4.1: Demonstrate evidence of interest and concern for natural resource stewardship.
• AG.4.2: Explain the environmental considerations of decision making in AFNR management.
Power, Structural and Technical (AG-PST)
1. Apply physical science principles and engineering applications related to mechanical equipment, structures, and biological systems to solve problems and improve performance in AFNR power, structural, and technical systems.
AG-PST 1.1: Select energy sources for power generation.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Earth and Space Science	
ESS3: Earth and Human Activity	
ESS3.A: Natural Resources	• Resource availability has guided the development of human society. • All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.

ESS3.C: Human Impacts on Earth Systems	• The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from careful observation of phenomena, or unexpected results · to clarify and/or seek additional information. · to determine relationships, including quantitative relationships, between independent and dependent variables. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
Developing and Using Models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
Planning and Carrying Out Investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Select appropriate tools to collect, record, analyze, and evaluate data. • Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.
Analyzing and Interpreting Data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
Using Mathematics and Computational Thinking	Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).
Engaging in Argument from Evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Crosscutting Concepts	
Cause and Effect: Mechanism and Prediction	• Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
	• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Understandings about the Nature of Science	
Scientific Investigations Use a Variety of Methods	• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.
Science Addresses Questions About the Natural and Material World.	• Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. • Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Algebra	
Seeing Structure in Expressions	*Write expressions in equivalent forms to solve problems.
Reasoning with Equations and Inequalities	Understand solving equations as a process of reasoning and explain the reasoning. Solve equations and inequalities in one variable.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
Craft and Structure	• **RST.9-10.4 –** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
Integration of Knowledge and Ideas	• **RST.9-10.7 –** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.1 –** Write arguments focused on discipline-specific content. • **WHST.9-10.1.B –** Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. **WHST.9-10.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • **WHST.9-10.2.A –** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.9-10.2.E –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. • **WHST.9-10.2.F –** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are potential energy sources used in the United States?
2. How is potential energy converted into kinetic energy?
3. What are the advantages and disadvantages of non-renewable energy?
4. What are the advantages and disadvantages of renewable energy?
5. What are renewable energy sources available in your area?
6. What are sources of electrical power?
7. Where is solar energy most productive?
8. How are diesel and gasoline similar?
9. What factors are considered when choosing a fuel?
10. What is a biofuel?
11. What are the similarities and differences between fossil and renewable fuels?

Lesson 6.2 This is My Land

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. All property is legally defined and recorded based on a standardized regulatory system.	• Describe parcels of land using the rectangular survey system and the metes and bounds system. (Activity 6.2.1)
2. Global Positioning System (GPS) is a method used to determine an exact location of a point on the earth using a coordinate system based on longitude and latitude readings.	• Use three points to triangulate a location. (Activity 6.2.2) • Determine latitude, longitude, and altitude using a GPS unit. (Activity 6.2.3)
3. Applications of Global Positioning System and Geographic Information System are used in all disciplines of agriculture and natural resource systems to improve agricultural production efficiencies and environmental quality.	• Collect soil data and record the GPS coordinates of each soil location. (Activity 6.2.4) • Use the Soil Web Survey to research information on each soil location. (Activity 6.2.4)
4. Federal, state, county, and local laws govern how land can be used.	• Discuss issues pertaining to zoning and land use and present a persuasive debate at a mock town hall meeting. (Activity 6.2.5)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

4. Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
11. Use technology to enhance productivity.
• CRP.11.01: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.
12. Work productively in teams while using cultural/global competence.
• CRP.12.02: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).
Natural Resource Systems (AG-NR)
1. Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.
• AG-NR 1.3: Obtain and analyze data by monitoring natural resource status.
Power, Structural and Technical (AG-PST)
5. Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.
• AG-PST 5.3 Use geospatial technologies in AFNR applications.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Earth and Space Science	
ESS3: Earth and Human Activity	
ESS3.A: Natural Resources	• Resource availability has guided the development of human society.

Understandings about the Nature of Science	
Scientific Investigations Use a Variety of Methods	• Science investigations use diverse methods and do not always use the same set of procedures to obtain data. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.
Scientific Knowledge is Based on Empirical Evidence	• Science knowledge is based on empirical evidence. • Science disciplines share common rules of evidence used to evaluate explanations about natural systems. • Science includes the process of coordinating patterns of evidence with current theory. • Science arguments are strengthened by multiple lines of evidence supporting a single explanation.

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Geometry	
Modeling with Geometry	*Apply geometric concepts in modeling situations.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.1 –** Write arguments focused on discipline-specific content.

	• **WHST.9-10.1.B –** Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. • **WHST.9-10.1.D –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. • **WHST.9-10.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.
Production and Distribution of Writing	• **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. Why is it important to provide accurate descriptions and directions when discussing land?
2. What systems are used to describe ownership of land?
3. What is triangulation and how is it used in GPS?
13. What is GIS?
14. How does GIS work with GPS?
15. What is zoning?
16. Why do groups disagree over land use?
17. What impact do zoning laws have on agriculture and natural resources?

Lesson 6.3 How It's Made

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. English and metric linear measurement systems are two useful forms of measurement used every day.	• Use English and metric measurement systems to determine the length of objects. (Activity 6.3.1) • Convert fractions and decimals. (Activity 6.3.1)
2. The proper use of scale is important when drafting and designing project plans.	• Use proportions to solve problems and determine dimensions of objects drawn to scale. (Activity 6.3.2) • Draw three-view plans of three-dimensional objects. (Activity 6.3.3)
3. Mechanical shop tools and materials have specific purposes.	• Develop a flowchart to classify 20 different tools. (Project 6.3.5)
4. Agricultural projects involve planning, design, construction, implementation, and evaluation.	• Write step-by-step directions for a coast-to-coast trip and calculate mileage and fuel cost. (Project 6.3.4) • Develop complete project plans for a birdhouse including researching the needs of the bird, designing, sketching, drawing, writing directions, and estimating a bill of materials. (Project 6.3.6)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
2. Apply appropriate academic and technical skills.
• CRP.02.01: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.
• CRP.02.02: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.
4. Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
Power, Structural and Technical (AG-PST)
4. Plan, build and maintain AFNR structures.
• AG-PST 4.1: Create sketches and plans of agricultural structures.
• AG-PST 4.3: Determine requirements and estimate costs for construction materials and procedures.
• AG-PST 4.4: Follow architectural and mechanical plans to construct AFNR structures.

Next Generation Science Standards Alignment

Science and Engineering Practices	
Asking Questions and Defining Problems	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
Developing and Using Models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Common Core State Standards for High School Mathematics

Modeling standards are indicated by the star symbol (*) throughout other conceptual categories.

CCSS: Conceptual Category – Number and Quantity	
Quantities	*Reason quantitatively and use units to solve problems.

CCSS: Conceptual Category – Algebra	
Seeing Structure in Expressions	*Write expressions in equivalent forms to solve problems.
Reasoning with Equations and Inequalities	Understand solving equations as a process of reasoning and explain the reasoning. Solve equations and inequalities in one variable.

CCSS: Conceptual Category – Geometry	
Geometric Measurement and Dimension	Visualize relationships between two-dimensional and three-dimensional objects.
Modeling with Geometry	*Apply geometric concepts in modeling situations.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10

Key Ideas and Details	• **RST.9-10.3** – Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What are the differences between the English and the metric system of linear measurement?
2. What is the proper way to read a ruler?
3. How are metric measurements converted from meters to centimeters to millimeters?
4. How are English measurements converted from inches to feet and from fractions to decimals?
5. How can proportions and ratios be used to calculate scale?
6. Why is the use of scale important in planning and design?
7. How do pictorial drawings differ from three-view drawings?
8. What object views are important when drawing plans?
9. Why are detailed instructions and directions critical to project planning?
10. How can mechanical tools be organized?
11. Why do tools have specific uses?
12. What is included in a bill of materials?
13. Why is research critical to planning and design?
14. What processes are involved in planning and design?

Lesson 7.1 Your Future in Agriscience

Concepts	**Performance Objectives**
Students will know and understand	*Students will learn concepts by doing*
1. Agriculture plays an essential role in society and feeding the world.	• Write a brief outlining a plan to be proposed at a hearing on solving world hunger. (Problem 7.1.1)
2. People develop goals to achieve their dreams.	• Write a vision statement and develop personal goals. (Activity 7.1.2)
3. Accurate record keeping is important to the success of an agricultural enterprise.	• Review their work from the year and complete their Career Portfolio. (Project 1.2.1)

National AFNR Common Career Technical Core Standards Alignment

Career Ready Practices
4. Communicate clearly, effectively and with reason.
• CRP.04.01: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
• CRP.04.03: Model active listening strategies when interacting with others in formal and informal settings.
5. Consider the environmental, social and economic impacts of decisions.
• CRP.05.02: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.
6. Demonstrate creativity and innovation.
• CRP.06.01: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
• CRP.08.02: Investigate, prioritize and select solutions to solve problems in the workplace and community.
10. Plan education and career path aligned to personal goals.
• CRP.10.01: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.
• CRP.10.04: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.
12. Work productively in teams while using cultural/global competence.
• CRP.12.01: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.
Agriculture, Food, and Natural Resources Career Cluster
2. Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role agriculture, food and natural resources (AFNR) play in society and the economy.
• AG 2.4: Explain the influence of AFNR on society.
4. Demonstrate stewardship of natural resources in AFNR activities.
• AG.4.2: Explain the environmental considerations of decision making in AFNR management.
5. Describe career opportunities and means to achieve those opportunities in each of the AFNR career pathways.
• AG.5.1: Locate and identify career opportunities that appeal to personal career goals.
• AG.5.2: Match personal interest and aptitudes to selected careers.
• AG.5.3: Provide examples and descriptions of various careers in each of the AFNR pathways.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Life Science	
LS4: Biological Evolution: Unity and Diversity	
LS4.D: Biodiversity and Humans	• Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). • Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.
Earth and Space Science	
ESS3: Earth and Human Activity	
ESS3.C: Human Impacts on Earth Systems	• The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 9-10	
Craft and Structure	• **RST.9-10.4 –** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
Integration of Knowledge and Ideas	• **RST.9-10.9 –** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

CCSS: English Language Arts Standards » Writing » Grade 9-10	
Text Types and Purposes	**WHST.9-10.1 –** Write arguments focused on discipline-specific content. • **WHST.9-10.1.A –** Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. • **WHST.9-10.1.D –** Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. • **WHST.9-10.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.
Production and Distribution of Writing	• **WHST.9-10.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.9-10.5 –** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. • **WHST.9-10.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
Research to Build and Present Knowledge	• **WHST.9-10.7 –** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • **WHST.9-10.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. • **WHST.9-10.9 –** Draw evidence from informational texts to support analysis, reflection, and research.
Range of Writing	• **WHST.9-10.10 –** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Essential Questions

1. What issues face the world population?
2. How can agriculture address future challenges to feed the population of the world?
3. Why is having a vision statement important?
4. What are SMART goals?
5. How are SMART goals used?
6. What is necessary to complete a career portfolio?
7. How can a portfolio help you find a job or be admitted to college?