CASE

Food Science and Safety
Expanded Lesson Review

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

Lesson 1.1 Exploring Food Science

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Sensory properties of food influence consumer preference and acceptance.	• Observe and identify three common foods using the five senses. (Activity 1.1.1) • Determine acceptability and preference of foods using sensory evaluation. (Activity 1.1.1)
2. Organization and record keeping are important to success in food science.	• Develop and keep an Agriscience Notebook to record and store information. (Activity 1.1.2) • Develop a Laboratory Notebook to record observations and protocols. (Activity 1.1.2)
3. Discoveries about food have driven advances in food processing and preservation.	• Work collaboratively to develop a timeline of food science discoveries. (Project 1.1.3) • Determine the date and significance of a food science discovery, scientist, organization, and/or event. (Project 1.1.3)

National AFNR Career Cluster Content Standards Alignment

Food Products and Processing Systems Career Pathway Content Standards
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.
• FPP.04.02: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.

Next Generation Science Standards Alignment

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.

Understandings about the Nature of Science	
Science is a Human Endeavor	• Scientific knowledge is a result of human endeavor, imagination, and creativity. • 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 11-12	
Key Ideas and Details	• **RST.11-12.2 –** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.10 –** 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 food science?
2. What will I study in a food science course?
3. What are the five senses?
4. How do scientists use the five senses in food science?
5. What is mouthfeel?
6. What is a consumer?
7. How does a consumer evaluate food preference using the senses?
8. Why are accurate laboratory notebooks important?
9. What are the essential components of laboratory notebooks?
10. What food processing or preservation techniques have had an impact on current food products?

Lesson 1.2 Science, Safety, and Inquiry

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Good laboratory procedures and safety ensure the quality and integrity of laboratory data.	• Diagram and describe where emergency equipment and safety hazards in the food science laboratory are located. (Activity 1.2.1)
2. Sanitation and cleanliness are critical for safety in food handling and preparation.	• Compare different methods of washing hands, workspace, and utensils, and determine which method is best. (Activity 1.2.2)
3. Foods are chemical systems comprised of lipids, simple and complex carbohydrates, proteins, vitamins and other molecules.	• Research the main nutrients from food needed in the human body. (Activity 1.2.3) • Detect nutrients, such as protein, starch, sugar, fat, and vitamin C, using indicator solutions. (Activity 1.2.3)

4. Rigorous, scientific research methods, including qualitative and quantitative analysis, are standard in the food industry.	• Investigate the presence of nutrients in unknown food sources using scientific inquiry and the scientific method. (Project 1.2.4)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.07: 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 Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Food Products and Processing Systems Career Pathway Content Standards
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.01: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.
• FPP.02.03: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

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. • Evaluate a question to determine if it is testable and relevant. • 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. • 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.
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

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 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 (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

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.

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 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Integration of Knowledge and Ideas	• **RST.11-12.8 –** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.D –** Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.10 –** 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 safety?
2. Why is it important to wash your hands and workspace in the laboratory?
3. What are proper procedures for hand washing?
4. What is the importance of soap and antibacterial cleaners in a food science laboratory?
5. What guidelines am I expected to follow when working in the laboratory?
6. What are the steps in the scientific method?
7. What is scientific inquiry?
8. How does a food scientist infer?
9. What are proteins, lipids, carbohydrates, and vitamins?
10. How are proteins, lipids, carbohydrates and vitamin C detected in food products?
11. What is the difference between qualitative and quantitative analysis?

Lesson 2.1 Influence of Nutrients in Food

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. The amounts of lipids, carbohydrates, proteins, and water in a food product influence sensory characteristics.	• Conduct sensory evaluations to ascertain how the amount of lipid, carbohydrates, proteins, and water affect sensory characteristics of food. (Activity 2.1.1, Activity 2.1.2, Activity 2.1.3, and Activity 2.1.4) • Examine properties and sensory characteristics of various starches for the ability to withstand time and temperature changes. (Activity 2.1.1) • Render fat from assorted meat products to determine the amount of lipids present. (Activity 2.1.2) • Dehydrate hotdogs and deli ham to determine the percentage of water in each food product. (Activity 2.1.3) • Examine elasticity of gluten in different flours. (Activity 2.1.4)
2. Ingredients have varying functionalities in food products.	• Research and determine the functions of ingredients in a basic cake recipe. (Activity 2.1.5)
3. Different ingredients can be used to produce the same product.	• Substitute ingredients in a recipe and use sensory analysis to determine acceptance of substitute ingredients. (Activity 2.1.6)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.

Agriculture, Food, and Natural Resources Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.03: Apply health and safety practices to AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Food Products and Processing Systems Career Pathway Content Standards
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.02: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
• FPP.02.03: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
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. • 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.
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	
Patterns	Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
	• Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.
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. • Changes in systems may have various causes that may not have equal 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.

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 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **.RST.11-12.4 –** 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 11-12 texts and topics**.**
Range of Reading and Level of Text Complexity	• **.RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
Range of Writing	• **WHST.11-12.10 –** 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 does the amount of water in a food product influence the sensory characteristics of a product?
2. What are the main functions of water in a food product?
3. Why do scientists consider water a universal solvent?
4. What are the main functions of lipids in a food product?
5. What are the three main lipids found in food?
6. What is the difference between fats and oils?
7. How does the amount of lipids in a food product affect sensory characteristics?
8. What properties do food scientists evaluate when they examine starches?
9. What is retrogradation?
10. What is the difference between opacity and translucency?
11. What functions do starches perform in food products?
12. What is the difference between amylose and amylopectin?

13. How do proteins affect the characteristics of a food product?
14. What are the main functions of proteins in a food product?
15. What ingredients can be used as leavening agents in food products?
16. What ingredients can you substitute in a food product and still get similar results?

Lesson 2.2 Food Chemists

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Food is constantly reacting with its environment.	• Observe foods of various ages to determine changes that have occurred over time. (Project 2.2.1)
2. Foods change over time due to chemical reactions, physical changes, microbiological growth and/or enzymatic activity.	• Culture swabs taken from food samples to determine the presence of microorganisms. (Project 2.2.1) • Prepare a bread recipe and observe changes to the ingredients that occur during the mixing and baking of the bread. (Activity 2.2.3)
3. pH is an essential solution property that influences chemical reactions, properties, quality, and safety of food.	• Determine the pH of common pantry ingredients and the functions of those ingredients in foods. (Activity 2.2.2)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.04: Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
CRP.07: 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.

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CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
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Next Generation Science Standards Alignment

Disciplinary Core Ideas

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. • 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.
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	
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. • Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
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.
	• Much of science deals with constructing explanations of how things change and how they remain stable. • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

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.

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.

Common Core State Standards for English Language Arts

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Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

Essential Questions

1. How does food change over time?
2. What factors influence changes that occur in foods?
3. How can microorganisms be detected in food?
4. What causes spoilage and decay in food?
5. What is the pH of common food items?
6. How does the pH of a food influence how it is used in recipes?
7. How are chemical reactions used in making bread?
8. What physical changes occur during baking?

Lesson 2.3 Factors of Change

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Physical changes can cause foods to crystallize, gel, and otherwise change over time.	• Research and present findings on common physical changes in food. (Project 2.3.1) • Demonstrate how to produce common physical changes in food. (Project 2.3.1)
2. Chemical reactions, such as Maillard browning and oxidation, can change food over time because food is a non-equilibrium system.	• Evaluate effects of storage of food products on Maillard browning. (Activity 2.3.2) • Conduct a sensory evaluation to determine the amount of change in a food product over time. (Activity 2.3.2)
3. pH influences the way a food reacts chemically as well as the sensory characteristics.	• Measure the amount of CO_2 gas produced in a chemical reaction with varying pH levels. (Activity 2.3.3) • Conduct a sensory evaluation difference test to determine if there is a difference in the taste of low acid orange juice compared to regular orange juice. (Activity 2.3.3)

National AFNR Career Cluster Content Standards Alignment

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• CRP.07.01: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.
CRP.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.

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	• Much of science deals with constructing explanations of how things change and how they remain stable.

	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
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Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

Essential Questions

1. What is a physical change.
2. What are five main physical changes used by food scientists?
3. What is an emulsion?
4. What is a suspension?
5. How are food products changed by crystallization?
6. What is a foam?
7. How is food a non-equilibrium system?
8. What are examples of chemical reactions in food?
9. What is Maillard browning?
10. How does pH influence chemical reactions in food substances?
11. How does pH affect characteristics of food?

Lesson 3.1 Good Manufacturing Practices

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

1. Personal hygiene is a critical GMP that is easily controlled	• Develop a sign, for display, outlining proper protocols for a personal hygiene topic and present information to class. (Project 3.1.1)
2. Good manufacturing practices can promote safe preparation and handling of food.	• Observe photographs of food science situations to determine what GMPs are being followed and identify those that are not. (Activity 3.1.2)
3. Allergens are food safety concerns and need to be addressed with proper food preparation and handling.	• Prepare foods using different sanitation methods and test for cross contamination. (Activity 3.1.2)

National AFNR Career Cluster Content Standards Alignment

Agriculture, Food, and Natural Resources Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.01: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
• CS.03.03: Apply health and safety practices to AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Food Products and Processing Systems Career Pathway Content Standards
FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
• FPP.01.01: Analyze and manage operational and safety procedures in food products and processing facilities.
• FPP.01.02: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.
FPP.03: Select and process food products for storage, distribution and consumption.
• FPP.03.01: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **.RST.11-12.4 –** 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 11-12 texts and topics.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.

Essential Questions

1. What are GMPs?
2. What are contaminants in food?
3. How can a GMP prevent contamination?
4. What are SSOPs?

5. Why are safety practices and procedures important?
6. What is personal hygiene?
7. What personal items are unsafe when working with food?
8. Describe how a food scientist should clean the workspace.
9. What is an allergen?
10. What is cross-contamination?
11. What procedures reduce the potential for cross contamination?

Lesson 3.2 ABCs of Food Safety

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. HACCP utilizes seven basic principles to assure potentially hazardous products do not reach the consumer.	• Research the principles of a HACCP plan and develop a Prezi presentation and handout to be used as an informational resource for other students. (Project 3.2.1)
2. HACCP concepts are used in all phases of food production and processing.	• Determine the HACCP principle explained in a scenario and justify the reasoning for that choice. (Activity 3.2.2)
3. HACCP is a framework for assessing and/or preventing risks associated with physical, chemical, and biological hazards in food design and manufacturing systems.	• Collaborate as a team and follow steps to develop a HACCP plan for ham and cheese sandwiches. (Activity 3.2.3)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.04: Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
CRP.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 Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.01: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
• CS.03.02: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.
• CS.03.03: Apply health and safety practices to AFNR workplaces.

Food Products and Processing Systems Career Pathway Content Standards
FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
▪ FPP.01.01: Analyze and manage operational and safety procedures in food products and processing facilities.
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.

- FPP.04.03: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Engineering, Technology, and the Application of Science	
ETS1: Engineering Design	
ETS1.A: Defining and Delimiting Engineering Problems	• Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
ETS1.B: Developing Possible Solutions	• When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
ETS1.C: Optimizing the Design Solution	• Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.

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 clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• 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.

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.
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. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.
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. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • 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.
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.
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.
	• Systems can be designed to do specific tasks.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • **RST.11-12.9 –** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
Range of Writing	• **WHST.11-12.10 –** 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 seven basic HACCP principles?
2. How are HACCP systems implemented throughout the food industry?
3. What are pre-requisite programs?
4. What is the difference between critical control points and critical limits?

5. What is the purpose of verification procedures?
6. What are important factors to consider about monitoring procedures?
7. Why are corrective actions included in the HACCP plan?
8. Where are corrective actions placed in the HACCP system?

Lesson 3.3 Pathogen Pathways

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Microbiological organisms can have positive and negative effects on foods and people.	• Research bacteria, mold, and yeast and record growth factors, appearance, and inhibiting methods. (Activity 3.3.1)
2. Microbial growth can be manipulated using temperature, pH, water activity, competitive exclusion, and chemical agents.	• Prepare agar for microbial growth and inoculate the agar with yeast. (Project 3.3.2) • Develop and conduct a protocol testing factors affecting microbial growth. (Project 3.3.2) • Write a laboratory report discussing findings and analyzing results of tests conducted. (Project 3.3.2)
3. Pathogens can cause illness or death when present in food.	• Research foodborne pathogens to discover diseases pathogens can cause and prevention methods to control pathogens. (Project 3.3.3) • Develop a comic strip depicting the information discovered about an assigned pathogen. (Project 3.3.3) • Collaborate with peers to determine possible pathogens that caused sickness in a role-play activity. (Activity 3.3.4)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.
CRP.04: 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.
CRP.07: 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.
• 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.
CRP.08: 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.

CRP.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 Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.01: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
• CS.03.03: Apply health and safety practices to AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

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.
BS.03: Demonstrate the application of biotechnology to solve problems in AFNR systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).
• BS.03.02: Apply biotechnology principles, techniques and processes to enhance the production of food through the use of microorganisms and enzymes.

Food Products and Processing Systems Career Pathway Content Standards
FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
▪ FPP.01.01: Analyze and manage operational and safety procedures in food products and processing facilities.
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.02: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome, and nutritious food supply for local and global food systems.
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.
• FPP.04.03: Identify and explain the purpose of industry organizations, groups, and regulatory agencies that influence the local and global food systems.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Life Science	
LS1: From Molecules to Organisms: Structures and Processes	
LS1.A: Structure and Function	• Systems of specialized cells within organisms help them perform the essential functions of life.

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. • Evaluate a question to determine if it is testable and relevant.

	• 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. • 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.
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.
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. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • 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.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. • 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	
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 Addresses Questions About the	• Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.

Natural and Material World.	• Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. • 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 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • **RST.11-12.9 –** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.1 –** Write arguments focused on discipline-specific content. • **WHST.11-12.1.A –** Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. • **WHST.11-12.1.B –** Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. • **WHST.11-12.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. • **WHST.11-12.9 –** Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing	• **WHST.11-12.10 –** 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 microbiological organisms?
2. In what ways are microorganisms helpful in food science?
3. How can microbes be a detriment to a food product?
4. What conditions are ideal for microbial growth?
5. What factors inhibit or regulate the growth of microorganisms?
6. Why is it important to understand how to manipulate microbial growth in food science?
7. What is a foodborne pathogen?
8. What are three microorganisms that occur as pathogens in the food supply?
9. What causes foodborne pathogens?
10. What ways can pathogens cause foodborne illnesses?
11. How can you prevent foodborne pathogens?

Lesson 4.1 Processing for Consumption

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Processing is a system that physically or chemically changes the inherent characteristics of agricultural products prior to consumption.	• Identify chemical and physical changes of strawberries, cream, and other ingredients while processing raw products into food products for consumption. (Activity 4.1.1)
2. Specific unit operations are dependent upon the chemical and physical properties of the raw food commodity.	• Generate a list of chemical and physical properties of apples and apple products. (Activity 4.1.2) • Identify unit operations used to process apples. (Activity 4.1.2) • Determine how physical and chemical properties of food affect unit operations. (Activity 4.1.2)
3. Processing methods are dependent upon the end uses of the agricultural products.	• Evaluate how processing methods affect the quality of strawberries and test which processed strawberry would better replace fresh strawberries in a recipe. (Project 4.1.3)
4. Agricultural commodities are processed and separated into components used for further processing or for consumption.	• Investigate methods used in processing poultry and determine what products can be derived from a raw commodity. (Problem 4.1.4) • Process a chicken into as many different food products as possible. (Problem 4.1.4)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards

CRP.02: 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.
CRP.06: Demonstrate creativity and innovation.
• CRP.06.01: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.
• CRP.06.03: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.
CRP.07: 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.
CRP.08: 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 Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.03: Apply health and safety practices to AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Food Products and Processing Systems Career Pathway Content Standards
FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
▪ FPP.01.02: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.
▪ FPP.01.03: Apply food safety procedures when storing food products to ensure food quality.
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.02: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
• FPP.02.03: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
FPP.03: Select and process food products for storage, distribution and consumption.
• FPP.03.02: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
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 clarify and refine a model, an explanation, or an engineering problem. • Evaluate a question to determine if it is testable and relevant. • 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. • 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.
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. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
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.
	• Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

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 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 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 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.

CCSS: English Language Arts Standards » Writing » Grade 11-12

Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
Range of Writing	• **WHST.11-12.10 –** 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 food processing?
2. What are differences between food processing and food preservation?
3. What are methods of food processing?
4. What chemical changes could occur during food processing?
5. What are physical changes that occur during food processing?
6. What are unit operations?
7. What are the basic principles in food preservation?
8. How do you observe chemical properties of food products?
9. What are examples of physical properties of food products?
10. What types of unit operations are responsible for chemically changing food properties?
11. What unit operations affect the physical properties of food?
12. Why are processing methods dependent upon the end use of the commodity?
13. How do the properties of raw commodities affect the processing methods used?
14. Why is food preservation important?
15. What processing methods also preserve food?
16. Why do some agricultural commodities need to be separated for further processing or consumption?
17. How has food processing made food more convenient for consumers?

Lesson 4.2 Processing for Preservation

Concepts	Performance Objectives
Students will know and understand 1. The five basic food-processing principles that achieve preservation are moisture removal, heat treatment, low-temperature treatment, acidity control, and non-thermal processes.	*Students will learn concepts by doing* • Evaluate microbial growth of buttermilk and heat-treated buttermilk. (Activity 4.2.1) • Manipulate pH levels of apples to inactivate enzymatic reactions and extend shelf life. (Activity 4.2.2) • Remove water from fruit to study the effects of water on microbes. (Activity 4.2.3) • Observe rate of deterioration of food products at room temperature, refrigeration, and freezing. (Activity 4.2.4)

	• Assess sensory characteristics of food products after processing. (Activity 4.2.3 and Activity 4.2.4) • Examine non-thermal processing methods in the food science industry and write a technical research paper on non-thermal processing methods. (Project 4.2.5)
2. Food preservation controls microbial growth and enzymatic reactions, extending the shelf life of a food while changing its quality and usability.	• Evaluate differences of minimally processed food products to processed food products and develop a conclusion statement on the effects of processing on food products. (Activity 4.2.6)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.
CRP.04: Communicate clearly, effectively and with reason.
• CRP.04.02: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.
CRP.07: 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.
• 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.
CRP.08: 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.
CRP.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.
CRP.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 Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.03: Apply health and safety practices to AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Food Products and Processing Systems Career Pathway Content Standards
FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
▪ FPP.01.02: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.
▪ FPP.01.03: Apply food safety procedures when storing food products to ensure food quality.
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.02: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

• FPP.02.03: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
FPP.03: Select and process food products for storage, distribution and consumption.
• FPP.03.02: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

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. • 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. • 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.
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. • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. • 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	
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. • 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.
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.
	• Much of science deals with constructing explanations of how things change and how they remain stable. • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. • Feedback (negative or positive) can stabilize or destabilize a system. • Systems can be designed for greater or lesser stability.

Common Core State Standards for High School Mathematics

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

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 11-12	
Key Ideas and Details	• **RST.11-12.1 –** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • **RST.11-12.8 –** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. • **RST.11-12.9 –** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.B –** Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. • **WHST.11-12.2.C –** Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. • **WHST.11-12.2.D –** Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.11-12.5 –** 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.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. • **WHST.11-12.9 –** Draw evidence from informational texts to support analysis, reflection, and research.
Range of Writing	• **WHST.11-12.10 –** 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 food scientists use heat to preserve food?

2. How do food products benefit from pasteurization?
3. What pH levels inactivate spoilage microbes?
4. What are factors to consider when controlling the acidity of a food product?
5. Is acidification a stand-alone processing method?
6. Why is moisture removal necessary to preserve food products?
7. What is the difference between dehydration and concentration?
8. What are the most common uses for concentration in the food processing industry?
9. How does moisture removal lower the costs of some food products?
10. How does freezing help in food preservation?
11. What is the main goal of low-temperature processing?
12. Does low-temperature processing kill most microorganisms?
13. What is irradiation?
14. What is packaging and its main purposes.
15. What are packaging methods that involve controlling the air around the food?
16. What are common materials used for packaging food products?
17. How does food preservation extend the shelf life of food?
18. Why is quality of food reduced during preservation?
19. How does preservation change the usability of a food product?
20. Why are specific time and temperature controls important in food preservation?

Lesson 4.3 Processing for Quality and Safety

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. A variety of federal, state, and local agencies govern the manufacture and sale of food.	• Research regulatory agencies and the laws that they regulate. (Activity 4.3.1) • Determine which agency is responsible for regulating specific food products. (Activity 4.3.1)
2. Agricultural commodities are graded based on their quality and usability, triggering some food products to have quality grading standards.	• Grade tomato catsup in accordance to USDA quality grading standards. (Activity 4.3.2)
3. Certain food products must meet legal standards of identity.	• Evaluate milk samples to determine if the product has been adulterated and types of adulterants. (Project 4.3.3)

National AFNR Career Cluster Content Standards Alignment

Agriculture, Food, and Natural Resources Cluster Skill Content Standards
CS.01: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
• CS.01.03: Identify public policies and examine their impact on AFNR systems.

CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.01: Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.

Food Products and Processing Systems Career Pathway Content Standards
FPP.03: Select and process food products for storage, distribution and consumption.
• FPP.03.01: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.
• FPP.04.03: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
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. • 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.
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	
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.
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.
	• Systems can be designed to do specific tasks.
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. • 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.
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.
	• Much of science deals with constructing explanations of how things change and how they remain stable. • Systems can be designed for greater or lesser stability.

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.

Science is a Human Endeavor	• Scientific knowledge is a result of human endeavor, imagination, and creativity. • Technological advances have influenced the progress of science and science has influenced advances in technology. • Science and engineering are influenced by society and society is influenced by science and engineering.
Science Addresses Questions About the Natural and Material World.	• Not all questions can be answered by science. • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. • 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 – Geometry	
Geometric Measurement and Dimension	• *Explain volume formulas and use them to solve problems. • Visualize relationships between two-dimensional and three-dimensional objects.

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	• *Understand and evaluate random processes underlying statistical experiments. • *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 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • **RST.11-12.8 –** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. • **RST.11-12.9 –** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.D –** Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

	• **WHST.11-12.5 –** 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.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. • **WHST.11-12.9 –** Draw evidence from informational texts to support analysis, reflection, and research.
Range of Writing	• **WHST.11-12.10 –** 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 does USDA regulate?
2. What are the roles of the FDA involving food safety and quality?
3. How does the EPA regulate the food industry?
4. What is the FSIS?
5. What are quality grading standards?
6. How are foods graded for quality?
7. What foods have quality grading standards?
8. Why are foods graded for quality and usability?
9. What is a standard of identity?
10. How do food products meet standards of identity?
11. Why are only certain food products required to meet legal standards of identity?

Lesson 5.1 Nourishing Nutrition Labels

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Food labels provide required and useful information, such as ingredients, nutrition, claims, traceability, warnings, and proper food handling for consumers.	• Dissect a nutrition label and examine each part to learn how to use a label to help consume a balanced diet. (Activity 5.1.1) • Investigate a food label to determine how to find required information and consumer warnings. (Activity 5.1.1)
2. Recommended dietary allowances provide guidelines for proper intake of macromolecules for health depending upon gender and different life stages.	• Determine recommended dietary guidelines for a specific set of individuals and develop a menu that contains the necessary nutrients for a healthy diet. (Problem 5.1.2)

3. Foods are analyzed and labeled based on their composition of various molecules.	• Recommend alternative foods for individuals with dietary restrictions. (Problem 5.1.2) • Research ingredients in a recipe to determine nutrient contents of each ingredient and develop a nutrition panel for the food product produced by the recipe. (Activity 5.1.3)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.06: Demonstrate creativity and innovation.
• CRP.06.01: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.
CRP.08: 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.
• CRP.08.03: Establish plans to solve workplace and community problems and execute them with resiliency.

Food Products and Processing Systems Career Pathway Content Standards
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.01: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.

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.
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.

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 – 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 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.10 –** 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 information is found on a nutrition label?
2. Why is it important to understand how to read a nutrition label?
3. What are percent daily values?
4. What are the requirements for the ingredients label?
5. What is claims information?
6. How are claims approved for use on a food label?
7. What is a nutrient content claim?
8. What is traceability?
9. Explain the importance of tracing a food product back to the manufacturer.
10. What food allergens are required to be included on a food label?
11. Why would food labels include proper handling guidelines?
12. What are recommended dietary allowances?
13. Why are recommended dietary allowances based on gender and different lifestyles?

Lesson 5.2 Safe, Secure, and Accessible

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Safe and nutritious food, necessary to maintain health, is not equally accessible to everyone.	• Analyze statistics about food insecurity in the United States and their community. (Activity 5.2.1) • Develop solutions to possible situations of food insecurity in their community. (Activity 5.2.1)
2. U.S. food supply needs protection from intentional adulteration.	• Evaluate vulnerabilities toward intentional adulteration of a packing plant in the United States. (Project 5.2.2) • Develop a food defense plan. (Project 5.2.2) • Consider possible ways to attack the food supply. (Project 5.2.2)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.04: 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.
CRP.05: 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.
CRP.06: Demonstrate creativity and innovation.
• CRP.06.01: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.
• CRP.06.02: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.
• CRP.06.03: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.
CRP.08: 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.
• CRP.08.03: Establish plans to solve workplace and community problems and execute them with resiliency.
CRP.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 Cluster Skill Content Standards
CS.01: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
• CS.01.01: Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.02: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.

Food Products and Processing Systems Career Pathway Content Standards
FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
• FPP.01.01: Analyze and manage operational and safety procedures in food products and processing facilities.
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.
• FPP.04.02: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.

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. • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations.
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. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
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. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
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. • 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. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).
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).

Understandings about the Nature of Science	
Science Addresses Questions About the Natural and Material World.	• Not all questions can be answered by science. • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. • 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 – Geometry	
Geometric Measurement and Dimension	• Visualize relationships between two-dimensional and three-dimensional objects.

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 11-12	
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.1 –** Write arguments focused on discipline-specific content. • **WHST.11-12.1.A –** Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. • **WHST.11-12.1.B –** Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. • **WHST.11-12.1.E –** Provide a concluding statement or section that follows from or supports the argument presented.
Production and Distribution of Writing	• **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
Range of Writing	• **WHST.11-12.10 –** 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 food security?
2. What factors affect food security?
3. What are indications of food insecurity?
4. How is obesity related to food insecurity?
5. What is food defense?

6. How does the United States protect the food supply from intentional adulteration?
7. What types of weapons might be used in an attack of the food supply?
8. Who could be a threat to the food supply?
9. What is food terrorism?
10. What is a food defense plan?
11. How is the Department of Homeland Security involved in food defense?

Lesson 6.1 Consumer Preferences

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Consumers choose food based on lifestyle factors including price, availability, convenience, culture, and nutrition.	• Evaluate a menu and consider choices based on nutrition, price, convenience, and culture. (Activity 6.1.1) • Choose food products based on lifestyle. (Activity 6.1.1)
2. Sensory evaluations must be carefully constructed and executed to reduce factors or biases that are not relevant to the test objective.	• Participate in sensory evaluation modeling factors to identify biases. (Activity 6.1.2) • Discuss how non-relevant factors can manipulate the perception of panelists. (Activity 6.1.2)
3. Different sensory evaluation techniques determine consumer preference and acceptance.	• Construct and conduct a specific sensory evaluation and collect data to analyze the outcome of the evaluation. (Project 6.1.3) • Develop an instructional guide explaining the steps and key points of a specific sensory evaluation. (Project 6.1.3)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.04: 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.
CRP.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 Cluster Skill Content Standards
CS.01: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.
• CS.01.01: Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.

Food Products and Processing Systems Career Pathway Content Standards
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.

• FPP.02.03: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.
• FPP.04.01: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.

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.
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. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
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. • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • 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).

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 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 – 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 11-12	
Key Ideas and Details	• **RST.11-12.1 –** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.B –** Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. • **WHST.11-12.2.D –** Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. • **WHST.11-12.9 –** Draw evidence from informational texts to support analysis, reflection, and research.
Range of Writing	• **WHST.11-12.10 –** 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 factors such as price, nutrition, and availability affect how consumers choose their food products?
2. How does convenience affect the choices consumers make on food product purchases?
3. What are biases?
4. How can biases or other non-relevant factors affect sensory evaluations?
5. How do you reduce biases in sensory evaluations?
6. What is a preference test?
7. What is a discrimination test?
8. What limitations exist within preference tests?

Lesson 6.2 To Protect and Sell

Concepts	Performance Objectives
Students will know and understand	*Students will learn concepts by doing*
1. Food marketing uses technology and media to influence consumer behavior.	• Compare different advertisements and determine how the marketer addressed product, price, place, and promotion. (Activity 6.2.1)
2. Food packaging both protects food and attracts consumers.	• Develop a food package to withstand a crush test, a drop test, and a water test while identifying the product and attracting consumers. (Project 6.2.2)
3. Food retailers position products based on shopping behaviors and consumer trends.	• Evaluate a store or market selling an assigned food product and evaluate the planogram and how the retailer marketed the product. (Activity 6.2.3)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.
CRP.06: Demonstrate creativity and innovation.
• CRP.06.03: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.
CRP.08: 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.
CRP.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.

Food Products and Processing Systems Career Pathway Content Standards
FPP.03: Select and process food products for storage, distribution and consumption.
• FPP.03.02: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.
FPP.04: Explain the scope of the food industry and the historical and current developments of food product and processing.
• FPP.04.01: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.
• FPP.04.02: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Engineering, Technology, and the Application of Science	
ETS1: Engineering Design	
ETS1.A: Defining and Delimiting Engineering Problems	• Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

ETS1.B: Developing Possible Solutions	• When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
ETS1.C: Optimizing the Design Solution	• Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.

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 refine a model, an explanation, or an engineering problem.
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. • 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.
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.
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. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
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.
	• Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.
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.
	• Systems can be designed to do specific tasks. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • 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.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. • 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.

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.
	• Much of science deals with constructing explanations of how things change and how they remain stable. • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

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 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.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 11-12	
Key Ideas and Details	• **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Production and Distribution of Writing	• **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.10 –** 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 technologies do researchers use in food marketing?
2. What types of media are used in food marketing?
3. How does social media affect consumer behavior?
4. What is the purpose of food packaging?
5. How does packaging protect food?
6. How does a food package attract customers?
7. What determines how retailers position food?
8. What is a planogram?

Lesson 7.1 Decide, Design, and Develop

Concepts	Performance Objectives
Students will know and understand 1. Food product development moves through a series of processes to transform from an idea to a tangible food product. 2. Finished food products must be validated against the original concept.	*Students will learn concepts by doing* • Choose a new food product to develop. (Activity 7.1.1) • Apply food processes necessary to develop a tangible food product from an idea. (Project 7.1.2) • Justify that a developed product meets consumer needs. (Project 7.1.3) • Develop a display to highlight new food product. (Project 7.1.3)

National AFNR Career Cluster Content Standards Alignment

Career Ready Practices Content Standards
CRP.02: 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.
CRP.04: 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.06: Demonstrate creativity and innovation.
• CRP.06.01: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.
• CRP.06.03: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.
CRP.07: 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.
CRP.08: 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.
CRP.09: Model integrity, ethical leadership and effective management.
• CRP.09.02: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards
CS.03: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.
• CS.03.02: Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.
• CS.03.03: Apply health and safety practices to AFNR workplaces.
• CS.03.04: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

Food Products and Processing Systems Career Pathway Content Standards

FPP.01: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
• FPP.01.01: Analyze and manage operational and safety procedures in food products and processing facilities.
• FPP.01.02: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.
FPP.02: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
• FPP.02.01: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.
• FPP.02.02: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
• FPP.02.03: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.
FPP.03: Select and process food products for storage, distribution and consumption.
• FPP.03.01: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.
• FPP.03.02: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

Next Generation Science Standards Alignment

Disciplinary Core Ideas	
Engineering, Technology, and the Application of Science	
ETS1: Engineering Design	
ETS1.A: Defining and Delimiting Engineering Problems	• Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
ETS1.B: Developing Possible Solutions	• When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
ETS1.C: Optimizing the Design Solution	• Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.

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 clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• 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). • 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.
	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.

Planning and Carrying Out Investigations	• 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. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. • 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.
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. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
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. • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • 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.
	• Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.
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.
	• Systems can be designed to do specific tasks. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
Structure and Function	The way an object is shaped or structured determines many of its properties and functions.
	• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. • 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.
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.
	• Feedback (negative or positive) can stabilize or destabilize a system. • Systems can be designed for greater or lesser stability.

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 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. • Individuals and teams from many nations and cultures have contributed to science and to advances in engineering. • Technological advances have influenced the progress of science and science has influenced advances in technology. • Science and engineering are influenced by society and society is influenced by science and engineering.
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. • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. • Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

Common Core State Standards for English Language Arts

CCSS: English Language Arts Standards » Science & Technical Subjects » Grade 11-12	
Key Ideas and Details	• **RST.11-12.1 –** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • **RST.11-12.3 –** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
Craft and Structure	• **RST.11-12.4 –** 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 11-12 texts and topics.
Integration of Knowledge and Ideas	• **RST.11-12.7 –** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • **RST.11-12.9 –** Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	• **RST.11-12.10 –** By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

CCSS: English Language Arts Standards » Writing » Grade 11-12	
Text Types and Purposes	**WHST.11-12.2 –** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • **WHST.11-12.2.A –** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. • **WHST.11-12.2.B –** Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. • **WHST.11-12.2.D –** Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. • **WHST.11-12.2.E –** Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
Production and Distribution of Writing	• **WHST.11-12.4 –** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

	• **WHST.11-12.6 –** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	• **WHST.11-12.7 –** 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.11-12.8 –** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. • **WHST.11-12.9 –** Draw evidence from informational texts to support analysis, reflection, and research.
Range of Writing	• **WHST.11-12.10 –** 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 stages in the food product development process?
2. How do food scientists determine the needs for a new food product?
3. What is a food trial?
4. How does a food scientist develop a formulation?
5. Why is consumer testing necessary when developing a new food product?
6. What is new food product validation?