

Food Science Unit 1: Introduction to Food Science

18 instructional days

Targeted Standards

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. [Clarification Statement: Emphasis is on explaining the meaning of

mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.* [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]

Science and Engineering Practices

Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)

Constructing Explanations and Designing Solutions

Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)

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. (HS-PS1-2)

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. (HS-PS3-3)

Obtaining, Evaluating, and Communicating Information

Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)

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. (HS-PS3-4)

Using Mathematics and Computational Thinking

Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)

Disciplinary Core Ideas**PS1.A: Structure and Properties of Matter**

The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2)

A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS1.B: Chemical Reactions

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)

The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2)

PS2.B: Types of Interactions

Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6)

PS3.A: Definitions of Energy

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1)

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer

Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4)

Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)

The availability of energy limits what can occur in any system. (HS-PS3-1)

Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

PS3.D: Energy in Chemical Processes

Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3), (HS-PS3-4)

Crosscutting Concepts**Patterns**

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. (HS-PS1-2),(HS-PS1-5)

Energy and Matter

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4), (HS-PS3-3)

Structure and Function

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. (HS-PS2-6)

Systems and System Models

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. (HS-PS3-4)

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. (HS-PS3-1)

Influence of Science, Engineering, and Technology on Society and the Natural World

Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS3-3)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)

Rationale and Transfer Goals :

The purpose of this content topic is to explore and understand factors connecting food science to all other relevant sciences while providing the historical and scientific developments of foods in a global society. Serving as an introduction to Food Science, this unit will serve as a foundation for the topics to follow, tying in real life examples in everyday foods and life. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of Food Science. The students will be able to apply and recognize what physiological factors humans use in selecting foods. Students will develop and investigate these physiological factors and the science of food marking. There will be an introduction to foodborne diseases and the effects of food processing on the microflora of foods, in which students can communicate scientific and technical information about why foodborne diseases spread. All topics will include the overarching theme of a STEM classroom.

Enduring Understandings:

Humans choose food based on several physiological factors, along with nutritional, cultural, psychological/sociological, and budgetary criteria.

Food manufacturers use both sensory and objective methods to help sell food

When people choose a particular food, they evaluate it based on sensory criteria

Volatile molecules and the effects of temperature explain the intensity of odors of food

The five basic types of taste (sweet, salty, sour, savory, and bitter) are interpreted by the four major sections on the human tongue.

Tastes, such as salty and sour, are related to the concentration of ions found in the food

Tastes can interact affecting the net sensory interpretation of food.

Texture is a combination of perceptions

The human diet is related to some of the leading causes of death

People get sick from food that has been contaminated by one of three types of hazards: biological, chemical, or physical.

Foodborne biological hazards include bacteria, molds, viruses, and parasites.

More than 90% of foodborne illness is bacterial.

Bacteria found in food can exist independently, while viruses require a host.

Chemical hazards are any chemical substances that are hazardous to health.

Essential Questions:

What drives people to choose different types of food?

How can basic research practices be used to investigate and study food science?

Why do hot peppers taste hot?

Why is the odor of something baking more intense than that of cold items such as ice cream?

How was the food pyramid established and why is it ever changing?

What are genetically modified organisms (GMO's), how are they made, and why do we need them?

What is the difference between common marketplace foods and foods classified as "organic"

What causes foodborne illnesses and how can they be prevented?

Why are some molds all right on foods while others are not?

What is the series of events that leads a bacterium, such as E.coli, to contaminate both hamburger meat and lettuce?

How are chemical hazards introduced into human food sources and what steps are being taken to prevent this?

Why do flavors differ in how quickly they are detected or how long they last?

| Content/Objectives | | Instructional Actions | |
|---|--|--|---|
| Content <i>What students will know</i> | Skills <i>What students will be able to do</i> | Activities/Strategies <i>How we teach content and skills</i> | Evidence (Assessments) <i>How we know students have learned</i> |
| <ul style="list-style-type: none"> The sensation of taste is a function controlled by the flow of dissolved food particles in saliva into gustatory cells found on | <ul style="list-style-type: none"> Provide an understanding of the chemical function and properties of major food components. | <ul style="list-style-type: none"> Structure lessons around questions that are authentic, relate to students' | <ul style="list-style-type: none"> Labs: <ul style="list-style-type: none"> Effects of Salt on Boiling Point Nutritional Main Meals and Global Issues |

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|--|--|---|--|
| <p>the tongue, which relays the message to the brain.</p> <ul style="list-style-type: none"> ● People choose foods that satisfy their senses of sight, smell, taste, touch, hearing, nutrient needs, cultural and religious beliefs, budget, and psychological factors. ● The three periods in the development of food. ● How food products and processing methods have changed due to contributions of food scientists. ● The role of scientists in the development of new food products. | <ul style="list-style-type: none"> ● Provide an understanding of the chemical interactions of food components and their effects on sensory and nutritional quality, functional properties, and safety of foods. ● Provide an understanding of the chemical basis of food preservation and the effects of processing and storage on food quality. ● Be Familiar with common analytical and experimental methods used in the study of the major food components. ● Examine the basis of food chemistry-related issues in food safety, regulation and current events. ● Define food science and relate it to other science disciplines. ● Relate the role of science to the development of the food industry. | <p>interests, social/family background and knowledge of their community.</p> <ul style="list-style-type: none"> ● Provide students with multiple choices for how they can represent their understanding. ● Provide opportunities for students to connect with people of similar backgrounds. ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures. | <ul style="list-style-type: none"> ● Product Production and Presentation ● Grocery Store Visit ● Developing Data tables ● Balancing Chewing Gum ● Measuring volumes of irregularly shaped objects ● Odor Recognition ● Taste Test Panel ● Imitation Apple Pie ● UNIT Test ● Quizzes ● Food Science Benchmark #1 |
| <p><u>Spiraling for Mastery</u> Where does this unit spiral back to other units from this or previous years</p> | | | |

in order to ensure that students retain mastery of what they've learned?

| Content or Skill for this Unit | Spiral Focus from Previous Unit | Instructional Activity |
|--|--|---|
| <ul style="list-style-type: none"> ● Provide an understanding of the chemical function and properties of major food components. ● Provide an understanding of the chemical interactions of food components and their effects on sensory and nutritional quality, functional properties, and safety of foods. ● Provide an understanding of the chemical basis of food preservation and the effects of processing and storage on food quality. | <ul style="list-style-type: none"> ● Foundations of chemical principles- Atomic structure, chemical compounds, and chemical reactions | <ul style="list-style-type: none"> ● Converting Recipes ● Sensory Evaluation Cryptogram ● News Update Activity ● Vocabulary anagram |
| <p>Key resources: "Principles of Food Science 3rd Edition" Janet Ward "Understanding Food- Principles and Preparation" Amy Brown</p> | | |
| <p>21st Century Life & Careers:</p> <p>9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.</p> <p>9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.</p> <p>9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.</p> | | |

Career Readiness, Life Literacies, & Key Skills:

9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).

9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.

9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.

9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.

Interdisciplinary Connections/Companion Standards:**NJSLS ELA**

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. (HS-PS1-5), (HS-PS2-6), (HS-PS3-4)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2), (HS-PS1-5), (HS-PS2-6)

WHST.9-12.5 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. (HS-PS1-2)

WHST.9-12.7 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. (HS-PS3-3), (HS-PS3-4)

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. (HS-PS3-4)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS3-4)

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4), (HS-PS3-1)

NJSLS Mathematics

MP.2 Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS3-1), (HS-PS3-3), (HS-PS3-4)

MP.4 Model with mathematics. (HS-PS1-4), (HS-PS3-1), (HS-PS3-3), (HS-PS3-4)

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2), (HS-PS1-4), (HS-PS1-5), (HS-PS2-6), (HS-PS3-1), (HS-PS3-3)

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4), (HS-PS3-1), (HS-PS3-3)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-4), (HS-PS1-5), (HS-PS3-1), (HS-PS3-3)

Companion Standards for ELA in Science and Technical Subjects: Reading

Key Ideas and Details

RST.11-12.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

Companion Standards for ELA in Science and Technical Subjects: Writing**Text Types and Purposes**

WHST.11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Production and Distribution of Writing

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.

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 an 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.