Unit 5: Engineering and Careers in Food Science

Content Area: **Science**
Course(s):
Time Period: **MP2**
Length: **18 days**
Status: **Published**

NJSLS - Science

9-12.HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
9-12.HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
9-12.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.
9-12.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).
9-12.HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
9-12.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.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' investigations, models, theories, simulations, and 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-LS1-6)

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

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 trade-off considerations. (HS-PS3-3)

Using Mathematics and Computational Thinking

Use mathematical representations of phenomena to support claims. (HS-PS1-7)

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

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 invasion 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, me), and refine the design accordingly. (HS-PS3-4)

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)

As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6)

PS1.A: Structure and Properties of Matter

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6)

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-PS1-5)

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-PS1-7)

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 quantitive property of a system that depends on the moon and interactions of matter and radiation within that system. That there is a single quantity called energy is because 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, and 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

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-LS1-6), (HS-PS3-3)

The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)

Patterns

Different paerns 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-PS1-5)

Structure and Function

Invesgang or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and the connections of components to reveal their functions and/or solve a problem. (HS-PS2-6)

Systems and System Models

When investing 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)

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-PS1-7), (HS-PS3-

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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)

Rationale and Transfer Goals

In this unit, students will be introduced to food microbiology, including sources of contamination in foods, foil spoiling, and how foods can be preserved through heating and cooling. More complicated descriptions of the makeup of foods will be discussed as the topic of foods acting as solutions, colloids, dispersions, and suspensions goes into greater detail. In this section, students will go into greater depth into the chemical makeup of the homogeneous and heterogeneous mixtures which many food products are classified as. Further research into how chemical compounds will be gone into greater depth as students will look into real-world recipes and discuss why certain ingredients are necessary for the recipe. Students will apply findings to real-world situations concerning the history of food preservation and its effect on the population. Students will also exhibit financial literacy in researching and developing comparisons of fresh, frozen, and canned foods. This unit is also designed to provide students with real-world experience in terms of what employment opportunities are available in the field of food production, going into depth into what attributes are appealing to employers and how students can make themselves more attractive to those employers. All topics will include the overarching theme of a STEM classroom

Enduring Understandings

- The food industry is one of the largest in the country and many jobs are related to the production and sale of food.
- Food becomes spoiled when contamination causes undesirable changes, and is usually caused by enzymes or microbes naturally found in foods.
- Pathogens have been found to enter the food supply in several different ways during food production and preservation.
- Methods of food preservation through heating and cooling can extend the shelf life of foods for months.
- Most foods are complex mixtures consisting of at least one dispersed phase of particles scattered through a continuous phase.
- Knowing the nature of mixtures can help both home cooks and food scientists produce more consistent, high-quality foods.
- Most foods can be preserved through heat or cold processing, which involves the transfer of heat energy either to or away from food.

Essential Questions

- Which qualities or skills that you find in yourself best support a food science career?
- After you pay for a meal at a restaurant, are you paying for just the food?
- The government sponsors and is involved with industry to develop new foods for space travel and combat. Why would the government not leave this solely up to the business sector?
- If the entire class went home and made muffins from a premade muffin mix, would each student's muffins turn out the same?
- If all available packaging materials were unsuitable for a new product, what variables would the product developers consider when designing a new packaging material?
- How can the solubility of salt explain why pure salt dissolves faster than rock salt?
- Oil and vinegar are used in salad dressings and are known to not be miscible. Some brands of salad dressing need to be shaken to mix up these ingredients, while others do not. Using chemical structure, explain the differences between these two.
- Why are dented, corroded, or damaged cans of food not a bargain at any price?
- Why is it likely that ears of corn sold at the supermarket are fresher and of better quality than those sold at a roadside farm stand, in terms of preservation?
- Why is it best to sweeten an infant's hot breakfast cereal with sugar rather than honey?

Content - What will students know?

- Biological hazards in food include bacteria, molds, viruses, and parasites. Chemical threats can come from compounds naturally found in plants, or those that are included unintentionally.
- To ensure food is preserved from preparation to purchase, methods of preservation trhrough heating or freezing are utilized
- Food packaging has several purposes, including protecting the food from biological and chemical hazards, increasing preservation of the food, and decreasing the cost of production for a company
- The solubility of macronutrients found in food can affect many variables concerning the food, including shelf life and taste
- Research is central to the development of every new food product
- The food industry is the largest in the United States and 1 in 4 jobs will be connected to the production, distribution, or sale of food.

Skills - What will students be able to do?

- Identify three main types of food contaminants.
- Differentiate among the types of foodborne illnesses.

- Name pathogens that cause foodborne illnesses
- Describe the two main ways pathogens enter the food supply
- Use food handling procedures that will help prevent the growth of illness-causing microbes
- Contrast the various methods used for commercial freezing and heat preservation.
- Evaluate variables that must be controlled to maintain the quality of refrigerated foods.
- Design packaging for various food types.
- Calculate the mass percent of solute in a solution.
- Compare colloids and solutes.
- Describe the factors that can affect the stability of foods.
- Identify and evaluate the steps involved in developing a new food product.
- Evaluate career opportunities related to foods in business, education, and government

Activities - How will we teach the content and skills?

- Structure lessons around questions that are authentic, and relate to students ' interests, social/ family background, and knowledge of their community.
- 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.
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.

Evidence/Assessments - How will we know what students have learned?

- Labs
    - Mold Growths in foods
    - Growing Bacterial Cultures
    - The Gram's stain test for bacteria
    - Comparing canned and frozen foods
    - Packaged design project
    - Measuring calories in a complex mixture
    - Extracting Gelatin and Fat
    - Developing a new food product
    - Preparing for a Job Interview
    - Agrotechnology Research and Application
- UNIT Test
- Quizzes
- Food Science Benchmark #2

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• Identify three main types of food contaminants. • Differentiate among the types of foodborne illnesses. • Contrast the various methods used for commercial freezing and heat preservation. • Identify and evaluate the steps involved in developing a new food product. • Evaluate career opportunities related to foods in business, education, and government.	• Explain the difference between pure substances and mixtures. • Compare physical and chemical reactions in laboratory experiments. • Identify sources of energy as potential or kinetic. • Differentiate among various forms of energy. • Explain the relationship between heat and temperature.	• Food Safety Tips • Food Preservation Options • Processing Pyramid • Mixture Matching Worksheet • Separating Mixtures • Calculang Mass Percent • Comparing Food Science careers

Key Resources

“Principles of Food Science 3rd Edition” Janet Ward

“Understanding Food- Principles and Preparation” Amy Brown

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 project 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 (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
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 (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
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 (e.g., NJSLSA.SL5).

Interdisciplinary Connections/Companion Standards

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