

**Family and Consumer Sciences Education**  
**Grades 9-12**

# **Food Science**





## Message to the Teacher

The Food Science course is based on the understanding that the ability to reason, to think toward themselves, their families, their peers, and the larger society. As technology and societies change, the basic need for food remains.

Research has shown that permanent acquisition of knowledge is most likely when learning occurs in context and repeated practice allowed. The experiential, hands on, real life nature of Food Science promotes this type of learning

Students live in a rapidly changing and increasingly complex world. Our students are future





6. Why is it important for students to study Food Science?

The Food Science course is based on the understanding that the ability to reason, to think critically and responsibly toward themselves, their families, their peers, and the larger society. As technology advances and societies change, the basic need for food remains.

Research has shown that permanent acquisition of knowledge is most likely when learning occurs in context and repeated practice is allowed. The experiential, hands on, real life nature of Food Science promotes this type of learning.

7. What instructional strategies best support student learning in Food Science?

The purpose of instructional strategies is to deliver the New York State Learning Standards in Family and Consumer Sciences, Career Development and Occupational Studies, and 12 Science Learning Standards. Teachers should develop learning experiences that are aligned with the standard.

The Food Science course should be taught using a hands on, experiential approach to learning so that knowledge and skills are applied in a planned, sequential manner.

Strategies could include, but are not limited to:

The Food Science classroom affords hands-on, relevant, real-world applications of academic standards in a nurturing environment. Students in Food Science may experience success in attaining academic standards that have given them difficulty in traditional academic settings.

Providing student access to other school staff (e.g., school counselors, school nurses, librarians, special education teachers, etc.) and community members (e.g., community members, etc.)

# Course: Food Science

## Content Topics

### The Introduction to Food Science

- A. Food Science and Its Relevance to Global Society (FS)

A.

representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity

NYS CDOS 1- Students will learn about the changing nature of the workplace, the value of work to society and the connection of work to the achievement of personal goals.

NYS CDOS 2- Students will use essential academic concepts, facts, and procedures in applications related to life skills and the world of work

NYS CDOS 3a2 Thinking Skills

NYS CDOS 3a3 Personal Qualities

NYS CDOS 3a4 - Interpersonal Skills

NYS CDOS 3a6 Managing Information

NYS CDOS 3a8 Systems

## Performance Objectives and Supporting Competencies for Food Science and Its Relevance to Global Society

### Food Science and Its Relevance to Global Society Performance Objective 1

- FS.1 Recognize food science as a relevant science including current and historical developments and advancements of global food production
  - FS.1.1. Define food science and relate it to other science disciplines
  - FS.1.2. Recognize the history and development of food into a highly regulated industry
  - FS.1.3. Relate the contribution of food science to the advancement of global food production
  - FS.1.4. Explain the importance of studying food science

**B. Research Practices in Food Science (RP)** How can I use basic research practices to investigate and study food science?

**Standards Connections**

Research Practices in Food Science supports the NYS Family and Consumer Sciences Learning Standards 1 ±Personal Health and Fitness and 2±A Safe and Healthy Environment; NYS Career Development and Occupational Studies Standards 1±Career Development, 2±Integrated Learning and 3a ±Universal Foundation Skills; and NYS Science Standards HS-PS1-2, HS-PS1-5, HS-PS1-6, and HS-PS1-11.

Rationale	Key Ideas
<p>The purpose of this content topic is to understand the role of research in food science as it relates to scientific practices and the development of the food industry. This content topic will provide opportunities for student to apply communication, leadership, management, and thinking skills to research practices in food science.</p>	<p>NYS FACS1 - Students will have the necessary knowledge and skills to establish and maintain physical fitness, participate in physical activity, and maintain personal health.</p> <p>NYS FACS 2- Students will acquire the knowledge and ability necessary to create and maintain a safe healthy environment.</p> <p>NYS Science HS-PS1-2 - Construct and revise an explanation for the outcome of a simple chemical reaction based on the most electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties</p> <p>NYS Science HS-PS1-5 ±Apply scientific principles and evidence to explain how the rate of a physical or chemical change is affected when conditions are varied.</p> <p>NYS Science HS-PS1-6 ±Refine the design of a chemical system by specifying a change in conditions that would produce increased amount of products at equilibrium</p> <p>NYS Science HS-PS1-11 ±Plan and conduct an investigation to compare properties and behaviors of acids and bases</p> <p>NYS CDOS 1- Students will learn about the changing nature of the workplace, the value of work to society and the connection of work to the achievement of</p>

personal goals.

NYS CDOS 2- Students will use essential academic concepts, facts, and procedures in applications related to life skills and the world of work

NYS CDOS 3a2 - Thinking Skills

NYS CDOS 3a3 Personal Qualities

NYS CDOS 3a4 Interpersonal Skills

NYS CDOS 3a6 Managing Information

NYS CDOS 3a8 Systems

## Performance Objectives and Supporting Competencies for Research Practices in Food Science

### Research Practices in Food Science Performance Objective 1

- RP.1 Explain the role of science in food science as it relates to research practices and practical scientific experiments
  - RP.1.1. Relate the role of science to the development of the food industry
  - RP.1.2. Identify and develop science skills necessary for successful scientific research
  - RP.1.3. Explain the steps of the scientific method and demonstrate its use in science investigations
  - RP.1.4. Design proper science experiments
  - RP.1.5. Demonstrate the knowledge and use of good and safe laboratory practices
  - RP.1.6. Explain the unique nature of clinical studies and acquire skills in evaluating scientific studies

C. Concepts of Physical Sciences Relevant to Food Science (PS) How will basic concepts of the physical sciences help me understand Food Science?

### Standards Connections

Concepts of Physical Sciences Relevant to Food Science supports the NYS Family and Consumer Sciences Learning Standard 2 – A Safe and Healthy Environment; NYS Career Development and Occupational Studies St



Concepts of Physical Sciences Relevant to Food Science Performance Objective 2

PS.2 Classify and identify compounds and common properties

PS.2.1. Explain the various types of chemical bonds and relate to the properties of compounds

Concepts of Physical Sciences Relevant to Food Science Performance Objective 5

PS.5 Identify the forms and sources of energy and understand their relationship to physical and chemical processes

PS



and the connection of work to the achievement of personal goals.

NYS CDOS 2- Students will use essential academic concepts, facts, and procedures in applications related to life skills and the world of work

NYS CDOS 3a2 Thinking Skills

NYS CDOS 3a3 Personal Qualities

NYS CDOS 3a4 Interpersonal Skills

NYS CDOS 3a6 Managing Information

NYS CDOS 3a7

E. Water (W) How can I explain the properties and role of water in food science?

**Standards Connections**

Food Science Applications of Water supports the NYS Family and Consumer Sciences Learning Standards 1 ±Personal Health and Fitness, 2 ±A Safe and Healthy Environment and 3 ±Resource Management; NYS Career Development and Occupational Studies Standards 1 ±Career Development and 2 ±Integrated Learning; and NYS Science Standards HS-ESS2-5, HS-PS1-5, HS-PS1-10, and HS-PS3-4

Rationale	Key Ideas
<p>The purpose of this content topic is to explore the properties of water in a scientific setting. Students will understand the composition and chemical formula of water and determine the freezing, melting, boiling and vaporization points of water and the influence of altitude on these temperatures. Students will understand the role of water in biological systems. Students will understand the <b>ERG\TV UHT</b> for water. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of the properties and role of water in food science.</p>	<p>NYS FACS 1- Students will have the necessary knowledge and skills to establish and maintain physical fitness, participate in physical activity, and maintain personal health.</p> <p>NYS FACS 2- Students will acquire the knowledge and ability necessary to create and maintain a safe and healthy environment.</p> <p>NYS FACS 3- Students will understand and be able to manage personal resources of talent, time, energy, and money and make effective decisions in order to balance their obligations to work, family, and self.</p> <p>NYS Science HS-ESS2-5 ±Plan and conduct an investigation of the properties of water and its effect on Earth materials and surface processes.</p> <p>NYS Science HS-PS1-5 ±Apply scientific principles and evidence to explain how the rate of a physical or chemical change is affected when conditions are varied</p> <p>NYS Science HS-PS1-10 ±Use evidence to support claims regarding the formation, properties, and behaviors of solutions at bulk scales.</p> <p>NYS Science HS-PS3-4 ±Plan and conduct an investigation to provide evidence that transfer of thermal energy when two components of different temperature are combined in a closed system results in a more uniform energy distribution among the components in the system (second law of</p>

thermodynamics)

NYS CDOS 1- Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.

NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

## Performance Objectives and Supporting Competencies for Water

### Water Performance Objective 1

- W.1 Analyze and describe the chemical composition and the three phases of water in the role of food preparation
  - W.1.1. Cite the composition and chemical formula of water
  - W.1.2. Determine the freezing, melting, boiling, and vaporization points of water and the influence of atmospheric pressure (altitude)
  - W.1.3. Demonstrate the use of water in food preparation for heat transfer and solutions
  - W.1.4. Describe the body requirements for water and its nutritional value
  - W.1.5. Demonstrate an understanding of osmosis

F. Carbohydrates (C) How can I analyze the properties and roles of carbohydrates in food science?

**Standards Connection**

Food Science Applications of Carbohydrates supports the NYS Family and Consumer Sciences Learning Standards 1 ±Personal Health and Fitness2 ±A Safe and Healthy Environment and 3 ±Resource ManagementNYS Career Development and Occupational Studies Standards 1 ±Career Development and 2 ±Integrated Learning; and NYS Science Standards HSLS1-6 and HSLS2-3

Rationale	Key Ideas
<p>The purpose of this content topic is to study the properties of carbohydrates. Students will be able to define mono and poly V D F F K D U L G H V D Q G H method of digestion, absorption and assimilation of carbohydrates. Students will be able to explain the nature of several carbohydrate related diseases such as diabetes hypoglycemia. Students will demonstrate caramelization and crystallization. Students will understand the composition of starches and their relationship with simple sugars. Students will be able to use starch cookery to demonstrate the use of starch in techniques such as gelatinization and thickening of sauces. Students will explain the sources and role of fiber in diets. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of carbohydrates in food science.</p>	<p>NYS FACS 1- Students will have the necessary knowledge and skills to establish and maintain physical fitness, participate in physical activity, and maintain personal health.</p> <p>NYS FACS 2- Students will acquire the knowledge and ability necessary to create and maintain a safe and healthy environment.</p> <p>NYS FACS 3- Students will understand and be able to manage personal resources of talent, time, energy, money and make effective decisions in order to balance their obligations to work, family, and self.</p> <p>NYS Science HSLS1-6 ±Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements.</p> <p>NYS Science HSLS2-3 ±Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.</p> <p>NYS CDOS 1- Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.</p> <p>NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.</p>



G. Lipids (L) How can I analyze the properties and roles of lipids in science?

### Standards Connections

Food Science Applications of Lipids supports the NYS Family and Consumer Sciences Learning Standards 1 ±Personal Health and Fitness2 ±A Safe and Healthy Environment and 3 ±Resource Managd

personal skills, aptitudes, and abilities to make career decisions.

NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

## Performance Objectives and Supporting Competencies for Lipids

### Lipids Performance Objective 1

- L.1 Analyze and describe the structure and compositions of lipids; explain lipid metabolism; develop techniques in selection and preparation of foods that avoid health problems related to lipids
  - L.1.1. Identify the basic structure and properties of lipids
  - L.1.2. Identify the dietary sources of lipids
  - L.1.3. Differentiate between saturated and unsaturated fats
  - L.1.4. Identify triglycerides and their roles as lipids
  - L.1.5. Explain advances in research regarding lipid metabolism included but not limited to omega, cis fats and trans fats
  - L.1.6. Describe the ingestion, digestion, absorption, and use of lipids in the human body
  - L.1.7. Examine diseases related to lipid consumption such as hypertension, atherosclerosis and obesity heart disease
  - L.1.8. Examine the relationship between cholesterol and lipids
  - L.1.9. Explain the five functions of fat in food preparation (tenderizing, aeration, heat medium, emulsions, and flavorings)
  - L.1.10. Develop techniques of food preparation that minimize fat absorption
  - L.1.11. Identify ways to reduce fat consumption through food preparation modifications

H. Proteins (P) How can I analyze the properties and roles of protein in food science?

Standards Connections

Food Science Applications of P

NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

## Performance Objectives and Supporting Competencies for Proteins

### Proteins Performance Objective 1

- P.1 Analyze and understand the chemical composition of proteins and recognize the essential and non-essential



- VM.1.2 Distinguish between fat and water soluble vitamins and their function in the body and implications to food preparation
- VM.1.3 Identify sources of vitamins
- VM.1.4 Explain the function of vitamins and identify conditions associated with deficiency and toxicity
- VM.1.5 Recognize the concept of bioavailability of vitamins and the factors that affect the bioavailability of vitamins

#### Vitamins and Minerals Performance Objective 2

- VM.2 Recognize the sources and types of minerals and identify the role of minerals in the efficient functioning body
  - VM.2.1 Describe the chemical nature of minerals
  - VM.2.2 Distinguish between micro and macro minerals and their functions in the body
  - VM.2.3 Identify sources of minerals
  - VM.2.4 Identify conditions associated with mineral deficiency and toxicity
  - VM.2.5 Recognize the importance of phytochemicals that reduce health risks for conditions such as but not limited to cancer and high cholesterol levels

**J. Introduction to Microorganisms (IM)** How can I identify the types and characteristics of microorganisms associated with food science?

**Standards Connections**

Introduction to Microorganism supports the NYS Family and Consumer Science Learning Standards 2 ±A Safe and Healthy Environment and 3±Resource Management; NYS Career Development and Occupational Studies Standards 1 ±Career Development, 2 ±Integrated Learning and 3a ±Universal Foundation Skills; and NYS Science Standards HS-LS2-2 and HS-LS2-6

**Rationale**

**Key Ideas**

The purpose of this content topic is to analyze microorganisms and their relation to food science. Students will identify major groups of microorganisms. Students will be able to distinguish various microorganisms based on structure, shape, temperature and oxygen requirement. Students will explore the impact of microorganisms as they relate to food products. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of microorganisms in food science.

NYS FACS 2- Students will acquire the knowledge and ability necessary to create and maintain a safe and healthy environment.

NYS FACS 3-



K. Microorganisms in Food Science(MFS) How can I understand the roles of microorganisms in food science?

### Standards Connection

Microorganisms in Food Science supports the NYS Family and Consumer Science Learning Standards 1 Sciences

NYS Science H~~PS~~16 ~~±~~Refine the design of a chemical system by specifying a change in condition that would produce increased amounts of products equilibrium

NYS CDOS 1- Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and ~~abilities~~ to future career decisions.

NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

NYS CDOS 3a1 Basic Skills

NYS CDOS 3a2 Thinking Skills

NYS CDOS 3a3 Personal Qualities

NYS CDOS 3a4 Interpersonal Skills

NYS CDOS 3a5 Technology

NYS CDOS 3a6 Managing Information

NYS CDOS 3a7 Managing Resources

NYS CDOS 3a8 Systems

NYS CDOS 3b Human and Public Service  
The student will be able to demonstrate a knowledge of principles of sanitation used to prevent the transmission of disease

- MFS.2.2 Identify and understand the metabolism of microbes that result in food intoxication
- MFS.2.3 Identify and understand the metabolism of microbes that result in food infections
- MFS.2.4 Identify the sources of microbial food contamination

L. Food Preservation(FP) How will I explain the concepts of food preservation and they relate to microorganisms and additives?

behaviors of solutions at all scales

NYS Science HS-PS3-1 Create a computational model to calculate the change in the energy of one component system when the change in energy of another component(s) and energy flows in and out of the system are known

NYS CDOS 1- Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.

NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

- NYS CDOS 3a1 Basic Skills
- NYS CDOS 3a2 Thinking Skills
- NYS CDOS 3a3 Personal Qualities
- NYS CDOS 3a4 Interpersonal Skills
- NYS CDOS 3a5 Technology
- NYS CDOS 3a6 Managing Information
- NYS CDOS 3a7 Managing Resources
- NYS CDOS 3a8 Systems

NYS CDOS 3b Human and Public Service The student will be able to demonstrate a knowledge of the principles of sanitation used to prevent the transmission of disease-producing microorganisms from one person/object to another.

## Performance Objectives and Supporting Competencies for Food Preservation

### Food Preservation Performance Objective 1

- FP.1 Analyze and describe methods of food preservation and their relationship to food safety
  - FP.1.1 Identify and explain methods of thermal preservation such as but not limited to blanching, pasteurization, and sterilization
  - FP.1.2 Recognize changes caused by processing food
  - FP.1.3 Explain dehydration as a means of food preservation
  - FP.1.4 Identify methods of packing and processing foods
  - FP.1.5 Describe the process of food irradiation and its effects on food
  - FP.1.6 Examine the procedural considerations for freezing of foods
  - FP.1.7 Describe the process of concentration and its effects on food
  - FP.1.8 Explain the effects of packaging on foods

FP.1.9. Review current research in the preservation and processing of





activities on the environment and biodiversity

NYS Science HPS 15 ±Apply scientific principles and evidence to explain how the rate of a physical or chemical change is affected when conditions are varied

NYS Science HPS 110 ±Use evidence to support claims regarding the formation, properties, and behaviors of solutions at bulk scales.

NYS CDOS 1- Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.

NYS CDOS 2-

FS.1.5. Recognize

**N. Technological Advances in Food Science (TA)** What is the impact of technology on the development of food science?

**Standards Connections**

Technological Advances in Food Science supports the NYS Family and Consumer Sciences Learning Standard 1 ±Personal Health and Fitness, 2 ±A Safe and Healthy Environment and 3 ±Resource Management; NYS Career Development and Occupational Studies Standards 1 ±Career Development, 2 ±Integrated Learning and 3a ±Universal Foundation Skills; and NYS Science Standards HS-LS1-8, HS-LS2-2, HS-LS2-7, and HSPS31

**Rationale**

The purpose of this content topic is to examine technological advances as well as current trends and issues in the food industry. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills in the study of technology in food science.

**Key Ideas**

NYS FACS 1- Students will have the necessary knowledge and skills to establish and maintain physical fitness, participate in physical activity, and maintain personal health.

NYS FACS 2- Students will acquire the knowledge and ability necessary to create and maintain a safe and healthy environment.

NYS FACS 3- Students will understand and be able to manage personal resources of talent, time, energy and money and make effective decisions in order to balance their obligations to work, family, and self.

NYS Science HS-LS1-8 ±Use models to illustrate how human reproduction and development maintain continuity of life.

NYS Science HS-LS2-2 ±Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity.

of the system are known.

NYS CDOS 1- Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.

NYS CDOS 2- Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

NYS CDOS 3a1 Basic Skills

NYS CDOS 3a2 Thinking Skills

NYS CDOS 3a3 Personal Qualities

NYS CDOS 3a4 Interpersonal Skills

NYS CDOS 3a5 Technology

## O. Food Industry Careers (FIC) How

workplace and other settings.

NYS CDOS 3a1 Basic Skills  
NYS CDOS 3a2 Thinking Skills  
NYS CDOS 3a3 Personal Qualities  
NYS CDOS 3a4 Interpersonal Skills  
NYS CDOS 3a5 Technology  
NYS CDOS 3a6 Managing Information  
NYS CDOS 3a7 Managing Resources  
NYS CDOS 3a8 Systems

## Performance Objectives and Supporting Competencies for Food Industry Careers

### Food Industry Careers Performance Objective 1

FIC.1 Identify occupations associated with food production, processing, preparation, and delivery

FIC.1.1 Locate resources to research food industry jobs

FIC.1.2 Relate careers with all the aspects of the food industry

FIC.1.3 Determine the training or qualifications required to perform specific jobs in the food industry

FIC.1.4 List personal attributes necessary for a successful career in the food industry

## Appendix A

			x Water Content in Foods
F. Carbohydrates (C)	CDOS1, 2	HS-LS1-6 HS-LS2-3	x Nutritional Main Meals and Global Issues
G. Lipids (L)	CDOS1,2	HS-LS1-6 HS-LS1-7	x Density Differences and Separations x Fat and Water Content of Ground Meat Products x Gluten Development in Dough, Nutritional Main Meals and Global Issues x Shortening Properties of Lipids in Pastry
H. Proteins (P)	CDOS1,2	HS-LS1-1 HS-LS1-2 HS-LS1-3	x Fat and Water Content of Ground Meat Products x Gluten Development in Dough x Nutritional Main Meals and Global Issues



## Appendix B

### Suggested Laboratory Experiences for Food Science

Food Science is a Family and Consumer Sciences foods and nutrition cluster course that has been designed as a specialized option to fulfill the third-year science graduation requirement for all students.

New York State mandates completion of three units of commencement level science for all students. The three units must be comprised of commencement level science courses aligned with the New York State P-12 Science Standards. Units must include one course from the physical setting (physical science) and one course from the living environment (life science). The third may be from either life sciences or physical sciences. Food Science has been designed as a specialized course to fulfill the science requirement for all students. All commencement level science courses, including specialized courses, include laboratory activities.

In science, specialized courses may include laboratory activities scheduled within the regular classroom instructional meeting time or may include additional laboratory time associated with earning a unit of credit. They do not include state-mandated laboratory experiments and do not end in a Regents examination.

Laboratory experiences are an integral part of the Food Science course. Laboratory experiences enable students to see how scientific principles are involved in food selection, preparation, and storage by applying knowledge, skills, and concepts introduced through classroom instruction.

The suggested laboratory experiences and Student Laboratory Form which follow are offered as suggestions to assist teachers in planning laboratories that promote an experiential approach to learning. Each of the following laboratories is connected to the objectives and supporting competencies in Food Science:

- x Acidity of Foods
- x Canning of Simple Items
- x Cheese Making
- x Density Differences and Separations
- x Effectiveness of Cleaning Products and Procedures on Microorganisms
- x Effects of Salt on Boiling Point

## Acidity of Foods

### Content Connections:

The Introduction to Food Science

B. Research Practice in Food Science (RFS)

C. Concepts of Physical Sciences relevant to Food Science (PS)

D. Concepts of Life Sciences relevant to Food Science (LS)

### Objectives:

Students will identify and develop science skills necessary for successful scientific investigations. Students will be able to explain the steps of the scientific method and demonstrate its use in science investigations. Students will understand the concept of pH and explain its relationship to neutralization reactions, and recognize examples of neutralization reactions and indicate the influence of pH on biological systems.

### Materials:

Litmus Paper

Water

Foods: pasta sauce, fruit yogurt, citrus juice, soups and foods common and easy to test.

### Procedure:

Acid level of foods has become a health issue for those millions that suffer from acid reflux and other digestion problems associated with high acidity of the stomach and esophagus. Simple litmus paper can be used to test several prepared foods and approximate acidity.

A review of the pH scale is critical. 14 would be the highest base or Alkaline number and 1 the most dangerous acidity. 7 is neutral and a typical stomach acid is somewhere in the 3 to 4 range.

Foods such as pasta sauce, yogurt, citrus juice and soups could be some foods that are common and easy to test. In all a variety of foods that might fall into basic or acidic should be chosen. Even water can and should be tested since it may be added to some of the products chosen.

A list should be kept and recorded. Foods could also be mixed (as throughout a meal) and a final pH could be taken of the mixed foods. Tomato sauce should always be used because of the extremely high levels of acid it can achieve.

At the end of the activity have students mix some baking soda (bicarbonate of soda) into tomato sauce and note the result. The baking soda will react and bubble in the very acid environment. Have students take the acid readings before and after adding the baking soda. Finally, a separate batch of sauce could have bay leaves added to note the change they have on acid levels.

Extensions:

Students can research the amount of money spent on digestive medications in the United States. Long term health effects can also be explored. Conditions (stomach/esophagus), inflammations, and cancers associated with high digestive acid levels.



## Cheese Making

### Content Connections:

Introduction to Food Science

C. Concepts of Physical Sciences Relevant to Food Science (PS)

Food Microbiology

K. Microorganisms in Food Science (M)

### Objectives:

Students will recognize the processes of chemical separation such as but not limited to distillation, evaporation, and crystallization. Students will know the process involved in the production of fermented products such as but not limited to yeast bread, vinegar, and cheeses. Students will demonstrate how simple processes (chemical bonding, natural bacterial processes, and precipitation) can yield a useful food source high in calcium protein and easy to preserve with vinegar, salting, and waxing. Students will use of various dairy products (butter milk, goat milk, and whole) to produce a variety of cheeses

### Materials:

Cheese making is a common lab activity done in biology classes across the country. The use of vinegar, hydrochloric acid HCL (1 molar or 8% solution), or the enzyme, renninase, can all be used safely and effectively to produce large amounts of simple cheeses. Salting or adding other spice can also be done with partial melting.

Precipitation agent (HCL 8%/ 1 molar or white vinegar, or renninase enzyme)

Cheese cloth (to separate the whey from curd)

Set of large spoons

Colander

Set of measuring cups

Variety of milks

Set of glass (not aluminum) bowls

### Procedure:

Teacher will demonstrate the process to the students. In a 1 quart pot milk is added and then the precipitant agent can be added. With gentle stirring the curd and whey will have separated to point where the combination can be poured through a cheese cloth and colander.

This lab activity can be taken very far. Some that were researched included the labbering of milk letting the natural lactobacilli bacteria create lactic acid which becomes the natural curdling agent.

Cheese making kits can be purchased for classroom use. Kits contain dried milk, dried bacteria

Extensions:

During yogurt making, watch the separation

Allow students to use a variety of milks (1%, 2%, whole, chocolate) and then spin up with the 1% molar hydrochloric acid solution.



Students in the same group will be timing how long it takes various types of vinaigrettes to separate after being shaken for 30 seconds. Students will predict what the separation rate will be if the two components are shaken for a longer period of time.

Tie-ins can be made with salad food and dressing preparation, minimum time to mix properly, and limit to separation time.

Dressing recipes can then be explored. After recipes have been completed the observation should once again be conducted. Did separation time increase or decrease? Did the use of spices and other ingredients increase the density and did it inhibit separation?

Extensions:

Culminating activity can be testing the dressings that have been created. Special attention should be paid to greens and their preparation. Stress the importance of serving dried greens so that water is removed from the surface. Have students mix their dressings with water and observe. Water and dressing rarely mix and to have their creations on the salad it should be served over dried greens.

# The Effectiveness of Cleaning Products and Procedures on Microorganisms in the Home

## Content Connections:

Intro to Food Science

B. Research Practices in Food Science (RP)

Food Microbiology

J. Introduction to Microorganisms (IM)

K. Microorganisms in Food Science (MFS)

## Objectives:

Students will evaluate the effectiveness of eliminating microorganisms from household surfaces through various cleaning processes and agents. Students will set up the parameters of their experiment using scientific method. An artificial work surface will be made using flat baking sheets and plastic film. A liquid solution of water and the juices from spoiled meat or poultry will be applied in a thin film and allowed to dry. Then, sectioning the surface off, students will do what they think the typical person would do at home. After cleaning the surface, they will collect samples from the cleaned surface and see if there are any microorganisms present.

## Materials:

Petri dishes prepared with nutrient agar

Stretch film to secure Petri dishes

Cotton swabs

Sterile water

Permanent markers

Masking tape

Plastic disposable glove

Safety goggles

Liquid from spoiled meat

Tap water

Flat surfaces (ex.: cardboard or baking sheets)

Dish detergent

Household sponges

Dish washing cloths

Paper towels

Various household (spray) cleansers appropriate for kitchen use

Plastic food storage wrap

Extra cardboard (old file folders will do)

## Procedure:

Student lab groups will cover the flat surface with a layer of plastic food wrap, section the surface into large grids with masking tape, and cover with another layer of plastic wrap.

Students will then apply the juice of the spoiled meat onto the surface, and allow it to dry.

While protecting the grids from overspray with the extra cardboard, they will spray one section with a chosen household cleanser, wipe it clean with a paper towel, and then collect a sample



## Effects of Salt on Boiling Point

### Content Connections:

Introduction to Food Science

C. Concepts of Physical Sciences relevant to Food Science (PS)

### Objective:

Students will use a variety of salts and concentrations in water to observe the effect on boiling point temperatures

### Materials:

Variety of salts (e. iodized and noniodized sea, organic salts)

Measuring utensils / cups

1 quart pots

Cooking thermometers

### Procedure

Students will measure equal amounts of three types of salts into equal amounts of water

Students will take temperature measurement both Fahrenheit and Celsius scales. Students will note any changes between varieties of salts

Students will conduct several more trials in which each time the concentration of salt is doubled

Data pertaining to salt concentration on boiling point will be kept

Five to six trials should be conducted and several groups may want to replicate procedure so several groups data can be plotted. Using log pro software or pencil on paper plot the results.

Students will create a mathematical ratio to determine how much quicker food cooked with a higher salt content in cooking water. Base lines will need to be established for common boiled foods like potatoes, pasta, and poached eggs.

### Extension:

Explore the aspect of changing boiling point on elevation. To cook in the mile high c

Denver, CO requires only a 206° and in Lake Tahoe water boils at 202°. The drop is caused by the decrease in air pressure (which allows liquid to go to a gas much easier) and translates into a loss of .9°F for every 500 feet.

Some students may research the health aspects of iodized salt (goiter formation) in history, as well as health related issues to a high sodium diet.

## Fat and Water Content of Ground Meat Products

### Content Connections:

The Introduction to Food Science

B. Research Practices in Food Science (RP)

Food Biochemistry

E. Water (W)

G. Lipids (L)

H. Proteins (P)

### Objectives:

Students will evaluate the fat and water content of different types of ground meat products. Fat will be rendered from the meat products by broiling them. The fat will be removed from the bottom of the broiling pan and placed in a container to harden overnight. Students will mass the fat and calculate how much of the ground meat sample is fat and how much of the mass loss is water. Students will also compare taste and juiciness of burgers from each ground meat and compare it to the fat and water content.

### Materials:

Balance

Bent edged spatula

Rubber spatula

Instant read thermometer

Marking pen

Masking tape

Cooking spray

Wax paper

454 g (1 pound) assigned ground meat product (meat samples may include beef containing 80%, 85%, 90%, 93%, or 97% fat as well as other options such as ground turkey, chicken, buffalo, or soy protein substitute)

Broiling rack

Beaker or cup

Paper towels

### Procedure:

Student lab groups will be assigned their ground meat portion. Students will mass their ground meat sample. Students will divide ground meat into four hamburger patties and place on a broiling rack, broiling to an internal temperature of 74-165°F. Students will remove the cooked hamburger patties and mass them. Students will scrape the drippings from the bottom of the broiling rack into a beaker or cup and set aside to cool. It may be overnight if necessary. When cool, the students will carefully lift the fat out of the beaker and blot dry on paper towels. Students will then mass the fat. Students will calculate what percentage of the ground meat sample consists of fat and conclude the remaining mass loss is water. Students will conduct a sensory evaluation of the four patties.

Extensions:

Research the role of fat in the diet and compare the nutritional value of animal fats to plant lipids.

Using Nutrition Facts Labels and ~~line~~ nutrient analysis, research the water and fat content of various meat products, such as hot dogs, and determine the ~~relationships~~ relationship between fat content and water content in these products.

Research food issues related to meat consumption and compare to ~~plant~~ plant protein in terms of health, cost, food safety issues, and protein content.



Extensions:

Research health conditions as they relate to wheat consumption and alternatives in food preparation.

Research the fiber content of various flours and the role of fiber in health.

Students can present their findings and recommendations to the class.

## Grocery Store Visit

### Content Connections:

Food Microbiology

L. Food Preservation (FP)

The Future of Food Science

O. Food Industry Careers (FIC)

### Objective:

Students will identify methods of packaging and processing foods. Students will locate resources to research food industry jobs.

### Procedure

The teacher should create a checklist of food items to investigate: fresh produce, baked items, dried goods, canned foods, and frozen meats and vegetables

Each student group will investigate:

1. How freshness is maintained (fresh, dried, irradiated, pasteurized, frozen)
2. What form of preservation is used (citric acid, ascorbic acid, chemical additives, etc.)
3. Where the product came from (location of origin)
4. Shelf life of each product

### Extension:

Students can present their findings. Bring in a digital camera so that images of what was investigated can be used in a power point presentation. Products that can be used in the home for long term storage should also be discussed.

Students can review current research in the preservation and processing of food.





## Product Production and Presentation (Suggested culminating project)

### Content Connections:

#### Future of Food Science

- N. Technology Advances in Food Science (TFS)
- O. Food Industry Careers (FIC)

### Objective:

Working in pairs, students will create a food product that they will market to a group of peers. Student groups will conduct research and create a marketable food product, including nutritional information, health risk or benefit, target consumer, and comparison of production cost vs. consumer cost. Students will present their findings to a panel of teachers and answer questions and answer session will culminate the presentation.

### Project Outline:

Student groups will present a product.

Students will conduct a presentation.

Students should dress the part of a marketing professional.

A product prototype should be present.

### Presentation should address the following concepts:

- x Inspiration for the food product (health, nutritional, new market, diet / exercise)
- x Research aspects (Is this a new product or one that is improved from an existing product?)
- x Ingredient research (What will go into your product and how will it be tested?)
- x Health benefit / risks (documented study or ingredient breakdown)
- x Packaging un-down (How and what type of materials in product and packaging)
- x Shipping proposal (small to large production, by rail, road, air, local, etc.)
- x Cost research (How much to produce, package, ship product vs. consumer product price?)
- x Profit margin

## Salt and Water Balance in Vegetables

### Content Connections:

The Introduction to Food Science

D. Concepts of Life Sciences Relevant to Food Science (LS)

FoodBiochemistry

E. Water (W)

I. Vitamins and Minerals (VM)

### Objectives:

Students will learn how the concentration of salt affects the movement of water into and out of the cell through its membrane.

### Materials:

Masking tape

Marking pen

250 ml distilled water

2 small bowls

15 ml table salt

Vegetable sample for each lab group (i.e., 2 large lettuce leaves, spinach and quartered cucumber, eggplant, zucchini, celery)

Timer

Balance

Paper towels

Spoon

### Procedure:

Students will pour half the water into each labeled bowl. Students will add the salt to one bowl and stir. Students will mass the vegetables before placing equal amounts into each bowl. After the vegetables soak in the bowls for 30 minutes, students will remove each of the vegetable samples, observing whether the vegetable is limp or crispy. After thoroughly drying each vegetable sample, they will be massed again and the amount of water loss will be calculated for each sample.

### Extensions:

Research the health related issues related to both high and low sodium diets.

Research the amount of sodium in various processed foods (i.e., cereals, potato chips, sauce, soup,) and compare to the sodium content of whole foods (i.e., fruits and vegetables)

Research health related issues related to other minerals (i.e., potassium, calcium, iron, or phosphorous)

Students can repeat this experiment, substituting sodium glutamate or potassium chloride in place of sodium chloride.

## Shortening Properties of Lipids in Pastry

### Content Connections:

The Introduction to Food Science

B. Research Practices in Food Science (RP)

C. Concepts of Physical Forces Relevant to Food Science (PS)

Food Biochemistry

G. Lipids (L)

### Objectives:

Students will experience why lipids are an important ingredient in baked goods. Students will measure the shortening properties of various lipids. Students will compare the flavor and texture of piecrusts prepared with various lipids.

### Materials:

Flour

Salt

Variety of lipids (i.e., hydrogenated shortening, hard margarine, vegetable oil, butter, tub margarine, liquid margarine)

100-ml graduated cylinder

Balance

Fork or pastry blender

Cookie Sheet

Aluminum foil

Oven mitt or potholder

Pizza cutter or knife

Sifter

Mixing bowl

Metric measuring spoons

Turner or spatula

Pastry blender (for all variations, except oil)

2 rulers

### Procedure:

Student lab groups will prepare a pie pastry using equal amounts of flour, salt, water, and one lipid. Students will pat out the pastry into a uniform square on an aluminum foil covered cookie sheet, cutting it into an equal amount of squares before baking.

After baking, each student will compare the flavor and texture of the piecrusts.

Extensions:

Research degree of saturation of various lipids and make a conclusion about the relationship between saturation and flakiness of pastries.

Research hydrogenation of lipids and the uses in extending shelf life of baked goods. Estimate the shelf life of pastry based on the degree of saturation in each lipid used in this experiment.

Research the effects of saturated fats, unsaturated fats, and trans fatty acids in the diet.

## Recognizing Sources of Vitamin C

Extensions:

Research Hypoand Hypervitaminosisand the diseases related to vitamin deficiency and excessive amounts.

Research how Food Scientists determined the minimum recommended dietary allowances for vitamins.

5 HVHDUFK WKH HIIHFW RI YDULRXV OLIHVW\OH FKRLFHV DQ  
metabolize vitamins (smoking, drug abuse, alcohol consumption, etc.)

## Water Content in Foods

### Content Connections:

Food Biochemistry

E. Water (W)

### Objective:

Students will calculate the % of water in fruits by the process of weighing and dehydrating common fruits (i.e. pineapple, apple, pears, mango,).

### Materials:

Variety of fruits that can be easily sliced and dehydrated (ie. apples, pears, kiwi, mango, bananas)

Standard measuring cup(s)

Digital scale or triple beam balance

Standard stackable dehydrator unit

### Procedure:

Students should work in a group setting for the initial part of the lab. A fruit must be selected by the group and 100 gm (approx. 1/4 pound) will be prepared to the manufacturing guideline specification for the dehydrator chosen.

The group will make an estimate of what percentage water content their fruit possesses. As close to 100 gms. of fruit will be prepared and weighed. It is easiest to use 100 gms. so that calculations are simplified. Any amount may be used. Ratio / proportion calculations will be reviewed and employed during the lab. All measurements should be kept to the nearest tenth. All information should be kept in data table form.

Students can also take data during the days to dehydrate. Since many of the fruits will be sliced in a rounded fashion, measurements of the diameter should be taken to note size loss.

At the end of the drying period the groups will once again weigh the original prepared fruit and compare and calculate the weight loss due to the evaporation of water.

Graphing of the data collected by all groups can be done as well as comparing the data to predictions. Each group should create their own graphing display using a variety of mediums and technologies.

### Extensions:

Further nutritional and preservation techniques can be discussed. Determining which fruits last the longest can also be determined as the class progresses. Use of simple preserving agent (i.e. citric acid, light coating of sugar).

FAMILY AND CONSUMER SCIENCES —FOOD SCIENCE  
STUDENT LABORATORY REPORT FORM

Student Name: \_\_\_\_\_

Laboratory Title: \_\_\_\_\_

Laboratory Date(s): \_\_\_\_\_

Laboratory Report Due Date: \_\_\_\_\_

Laboratory Purpose:

Materials:

Laboratory Proc0.005 0 1 7 (or)u(or)(ato( : \_\_TJ ET Q q 0.00000912 0 612 792 re W\* n BT /F2 12

## Appendix C

### FAMILY AND CONSUMER SCIENCES & FOOD SCIENCE BEST PRACTICES RUBRIC AND LEARNING EXPERIENCE TEMPLATE

Indicators	1 Falls Below Expectations	2 Approaches Expectations	3 Meets Expectations	4 Exceeds Expectations
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PLANNING	
Curriculum Goal	
Essential Question(s)	
National Standards	
NYS Standards	



- PS.3.1. Describe the nature of synthesis reactions and recognize examples of this type of reaction
- PS.3.2. Describe the nature of decomposition reactions and recognize examples of this type of reaction
- PS.3.3. Understand the concept of pH and explain its relationship to neutralization reactions, and recognize examples of neutralization reactions
- PS.3.4.





- P.3 Recognize the changes that take place during the preparation of proteins and identify protein analogs
  - P.3.1. Recognize cases of denaturation and coagulation of protein
  - P.3.2. Relate the structure and nature of protein to specific types of food preparation such as but not limited to gelatinization and emulsification
  - P.3.3. Demonstrate the impact of cooking methods on meat proteins
  - P.3.4. Identify protein analogs

#### I. Vitamins and Minerals (VM)

- VM.1 Recognize the sources and types of vitamins and identify the role of vitamins in the efficient functioning of the body
  - VM.1.1. Describe the general chemical structure of vitamins
  - VM.1.2. Distinguish between fat and water soluble vitamins and their function in the body and implications to food preparation
  - VM.1.3. Identify sources of vitamins
  - VM.1.4. Explain the function of vitamins and identify conditions associated with deficiency and toxicity
  - VM.1.5. Recognize the concept of bioavailability of vitamins and the factors that affect the bioavailability of vitamins
  
- VM.2 Recognize the sources and types of minerals; and identify the role of minerals in the efficient functioning body
  - VM.2.1. Describe the chemical nature of minerals
  - VM.2.2. Distinguish between micro and macro minerals and their functions in the body
  - VM.2.3. Identify sources of minerals
  - VM.2.4. Identify conditions associated with mineral deficiency and toxicity
  - VM.2.5. Recognize the importance of phytochemicals that reduce the health risks of conditions such as but not limited to cancer and high cholesterol levels

#### J. Introduction to Microorganisms (IM)

- IM.1 Investigate microorganisms in terms of classification and growth and their application to food science

- MFS.1.1. Distinguish between aerobic and anaerobic respiration
- MFS.1.2. Define and identify the different kinds of fermentation processes
- MFS.1.3. Describe the process involved in the production of fermented products such as but not limited to yeast bread, vinegar, and cheeses
- MFS.1.4. Recognize the changes in nutritional value of foods caused by fermentation

MFS.2 Investigate harmful microorganisms and their effects on food products

- MFS.2.1. Distinguish between food intoxication and food infection
- MFS.2.2. Identify and understand the metabolism of microbes that result in food intoxication
- MFS.2.3. Identify and understand the metabolism of microbes that result in food infections
- MFS.2.4. Identify the sources of microbial food contamination

L. Food Preservation (FP)

FP.1 Analyze and describe methods of food preservation and their relationship to food safety

- FP.1.1. Identify and explain methods of thermal preservation such as but not limited to blanching, pasteurization, and sterilization
- FP.1.2. Recognize changes caused by processing food
- FP.1.3. Explain dehydration as a means of food preservation
- FP.1.4. Identify methods of packing and processing foods
- FP.1.5. Describe the process of food irradiation and its effects on food
- FP.1.6. Examine the procedural considerations for freezing of foods
- FP.1.7. Describe the process of concentration and its effects on food
- FP.1.8. Explain the effects of packaging on foods
- FP.1.9. Review current research in the preservation and processing of food

FP.2 Analyze types and functions of food additives, and identify common food additives and their roles in foods

- FP.2.1. Define the functions of additives
- FP.2.2. Identify the natural and synthetic additives used in foods
- FP.2.3. Differentiate incidental and intentional additives
- FP.2.4. Describe the desirable and undesirable properties of food additives
- FP.2.5. Identify problems associated with food additives
- FP.2.6. Outline the process of FDA approval of food additives

M. Food Safety (FS)

FS.1 Analyze and describe methods of food preservation and their relationship to food safety

- FS.1.1. Identify the sources of physical contamination
- FS.1.2. Identify the sources of chemical contamination
- FS.1.3. Identify the sources of toxic contamination
- FS.1.4. Recognize the complications of improper food handling, including, but not limited to cross-contamination, temperature control, and poor personal hygiene

- FS.1.5. Recognize and explain the concepts of bioaccumulation in the food supply
- FS.1.6. Outline voluntary efforts and government regulations related to sanitation in the food industry

- FS.2. Establish a safe working environment within the food industry
  - FS.2.1. Analyze and describe examples of health and safety problems in career areas
  - FS.2.2. Identify and describe safety equipment appropriate for handling specific kinds of job-related materials
  - FS.2.3. Analyze and develop safety rules to minimize health and safety hazards
  - FS.2.4. Describe procedures necessary to combat an emergency in a workplace
  - FS.2.5. Identify government regulations for workers in the food industry

#### N. Technological Advances in Food Science (TA)

- TA.1. Explore technological advances in food science
  - TA.1.1. Examine the uses of biotechnology to improve the food supply
  - TA.1.2. Examine the uses of genetic engineering to improve the food supply
  - TA.1.3. Examine the process of developing new products in the food industry
  - TA.1.4. Examine current issues and trends in the food industry

#### O. Food Industry Careers (FIC)

- FIC.1. Identify occupations associated with food production, processing, preparation, and delivery
  - FIC.1.1. Locate resources to research food industry jobs
  - FIC.1.2. Relate careers with all the aspects of the food industry
  - FIC.1.3. Determine the training or qualifications required to perform specific jobs in the food industry
  - FIC.1.4. List personal attributes necessary for a successful career in the food industry

