# Family and Consumer Sciences Education

**Grades 9-12**

# Food Science

The University of the State of New York
The State Education Department
Office of Curriculum and Instructional Support
Albany, New York 12234
2020 Update

# Acknowledgements

Numerous educators contributed to the original Applied Food Science curriculum guide in 1988. In 2006, this curriculum revision was begun by teachers from the Mohawk Valley Area of the New York State Association of Family and Consumer Sciences Educators. The update was completed by a statewide writing team brought together by the New York State Education Department in 2007 - 2009. This new and completely revised document brings the commencement level Food Science curriculum into alignment with all educational requirements and recommendations at the state and national levels. A special thank you goes to the New York State Association of Family and Consumer Sciences Educators board for their foresight and direction in coordinating this project.

Next Generation Science Standards Update Team 2020

| | |
|---|---|
| Rosemarie Avanzato | SUNY Oneonta, Oneonta |
| Dawn Mastroianni | CTE Technical Assistance Center, Rexford |
| Rosemarie Posillico | CTE Technical Assistance Center, Rexford |
| Christina Rode | CITI (Oswego) BOCES, Mexico |
| Dr. Constance Spohn | CTE Technical Assistance Center, Rexford |
| Elisse Wolf | Cole Middle School, East Greenwich RI |

| | |
|---|---|
| Kelli Grab | New York State Education Department, Albany |
| Michael LaMastra | New York State Education Department, Albany |

Curriculum Writing Team 2007-2009

| | |
|---|---|
| Doreen L. Cechnicki | Schenectady City Schools, Schenectady |
| Ann Coleman | Niskayuna Central Schools, Niskayuna |
| Helaine Donn | Hilton High School, Hilton |
| Deborah Hall | Cobleskill-Richmondville Central School, Cobleskill |
| Tracy Henry | North Colonie Central Schools, Latham |
| Heidi Hobbs | North Syracuse Central School District, Syracuse |
| Barbara Mikler-Crandon | Newark High School, Newark |
| William Ramesh Panaram | Bronx Academy High School, Bronx |
| Rosemarie Posillico | Burnt Hills-Ballston Lake Central Schools, Burnt Hills |
| Patricia Pultorak | G.W. Fowler High School, Syracuse |
| Marta Roberts-Pekar | Burnt Hills-Ballston Lake Central Schools, Burnt Hills |
| David Ritrovato | Scotia-Glenville Central Schools, Scotia |
| Cindy Rundblad | Duanesburg Central School, Delanson |
| Eleanor Sicluna | Albany City Schools, Albany |
| Sally Taibe | Warrensburg Central School District, Warrensburg |
| Dolores Talmadge | Canajoharie Central School, Canajoharie |
| Shirley Ware | North Syracuse Central School District, Syracuse |
| Constance Zack | Scotia-Glenville Central Schools, Scotia |

| | |
|---|---|
| Dawn B. Scagnelli | New York State Education Department, Albany |

## Foreword

This publication provides guidance to those responsible for planning, implementing, and assessing the commencement level Family and Consumer Sciences Food Science course. Food Science has been designed as a specialized option to fulfill the third year science graduation requirement for all students (See Appendix A).

Food Science is one of the courses in the Family and Consumer Sciences Food and Nutrition Learning Strand. Courses in the Food and Nutrition Learning Strand include:

Food and Nutrition CORE
Food Preparation and Nutrition
Nutrition, Health and Fitness
Global and Gourmet Foods
Commercial Food Program
Food Science (may be used for 1 science credit)

Food Science can be combined with other courses in this strand to create the content for a NYS Approved CTE program (see http://www.p12.nysed.gov/cte/ctepolicy/).
NYS Approved CTE programs offer students:

- an opportunity to apply academic concepts to real-world situations;
- preparation for industry-based assessments or certifications;
- the opportunity to earn college credit or advanced standing while still in high school;
- work-based learning opportunities where students demonstrate mastery of skills essential in the workplace;
- an avenue for meeting requirements of the CTE graduation pathway; and
- an opportunity to earn a technical endorsement on their diplomas.

Family and Consumer Sciences courses promote student attainment of the commencement level New York State Learning Standards in Family and Consumer Sciences and New York State Learning Standards in Career Development and Occupational Studies. In addition, Food Science meets commencement level New York State P-12 Science Learning Standards. Family and Consumer Sciences courses are also aligned with the National Family and Consumer Sciences Learning Standards (see http://www.nasafacs.org/national-standards-and-competencies.html).

Like all high school CTE courses, Food Science encourages student application of academic content, acquisition of technical skills, and demonstration of employability skills (life/career abilities). Family and Consumer Sciences education is one of the content areas covered by the Career and Technical Education (CTE) umbrella. As such, Commissioner's Regulations and NYSED policies developed for CTE programs and students apply to Family and Consumer Sciences.

# Message to the Teacher

The Food Science course is based on the understanding that the ability to reason, to think critically and creatively, and to reflect on one's actions, will empower students to act 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

Students live in a rapidly changing and increasingly complex world. Our students are future family, community and career leaders, and citizens. As citizens of tomorrow, they need to be able to synthesize information, utilize prior knowledge, work cooperatively, and apply critical thinking skills as they progress along their divergent paths. As Family and Consumer Sciences teachers, our charge is to empower students by engaging them in experiential activities that will guide them into the future.

# Curriculum Overview — Food Science

## 1. What is Food Science?

Food Science is designed to reinforce and enhance the student's knowledge of scientific principles and processes through the study of foods and nutrition. An in-depth understanding of science as it applies to foods will assist students in understanding the importance of the food industry and food preparation in their daily lives. Whenever possible, students should be involved in hands-on laboratory activities which verify the scientific concepts presented.

## 2. What is the graduation requirement for science education and how can Food Science help students meet that requirement?

New York State requires all students to complete at least three units of commencement level science to earn a diploma. The three units must be comprised of commencement level science courses aligned with the New York State P-12 Science Learning Standards. Units must include one course from the physical sciences and one course from the life sciences. The third may be from either physical sciences or life sciences. Food Science has been designed as a specialized course to fulfill the third-year science requirement for all students. All commencement level science courses, including specialized courses, must 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 the state-mandated laboratory requirement and do not end in a Regents examination for science.

Specialized courses must be approved for academic credit by the appropriate school official, usually the superintendent of schools.

## 3. Who can teach Food Science?

All Family and Consumer Sciences courses must be taught by a certified Family and Consumer Sciences teacher.

## 4. How is Food Science organized?

Food Science is organized into four disciplines and fifteen content topics. The disciplines are Introduction to Food Science, Food Biochemistry, Food Microbiology, and The Future of Food Science. Each discipline is composed of content topics:

**The Introduction to Food Science**

A. Food Science and Its Relevance to Global Society (FS)
B. Research Practices in Food Science (RP)
C. Concepts of Physical Sciences Relevant to Food Science (PS)
D. Concepts of Life Sciences Relevant to Food Science (LS)

**Food Biochemistry**

E. Water (W)
F. Carbohydrates (C)
G. Lipids (L)
H. Proteins (P)
I. Vitamins and Minerals (VM)

**Food Microbiology**

J. Introduction to Microorganisms (IM)
K. Microorganisms in Food Science (MFS)
L. Food Preservation (FP)
M. Food Safety (FS)

**The Future of Food Science**

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

Each content topic is introduced with an Essential Question followed by:

- The Standards Connection(s)
- Key Ideas
- A Rationale
- Performance Objectives and Supporting Competencies

Academic skills and employability skills (life/career abilities) are not to be taught separately, but rather embedded throughout the course using the focus of the essential questions.

**5. How does the Food Science curriculum relate to the Learning Standards?**

This course is a vehicle through which commencement level New York State Learning Standards for Family and Consumer Sciences can be attained. It also addresses the commencement level New York State Learning Standards for Career and Occupational Studies. The New York State P-12 Science Learning Standards are a focus of this curriculum.

Food Science content topics align with the National Learning Standards for Family and Consumer Sciences.

**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 creatively, and to reflect on one's actions, will empower students to act 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 P-12 Science Learning Standards. Teachers should develop learning experiences that are aligned with these standards.

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:

- Applied Academics
- Demonstrations
- Experiments
- FCCLA activities
- Group discussions
- Group problem solving
- Interviews
- Laboratory experiences
- Library research
- Multi-age activities
- Projects
- Scenarios
- Shadowing

Appropriate technology should be incorporated into any selected strategy.

It is recommended that the course be delivered within a laboratory setting and involve a minimum of 75% hands-on instruction. The use of real-world relevant tasks, laboratories, simulations, and scenarios, is an integral part of the course as is the use of library research, class discussions, and group activities. The student is expected to be actively involved in learning in a participatory, supportive environment and to have the opportunity to practice and develop skills related to the course content.

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 will strengthen their network of academic and personal support.

**8. How does Food Science support positive youth development?**

In addition to strong academic achievement, positive youth development is essential in educating youth today. Projects, leadership opportunities, and service learning experiences through Family, Career and Community Leaders of America (FCCLA) enhance the content topics of the Family and Consumer Sciences curricula. Students have the advantage of a practical forum to demonstrate leadership skills in an action-oriented format and have the potential for recognition of their achievement at the local, state, and national levels.

**9. How can special needs students succeed in Food Science?**

Students with special educational needs are included in Food Science classes. Family and Consumer Sciences educators acknowledge the need to differentiate instruction, recognize multiple intelligences and maximize the strengths of varied learning styles to accommodate all students. This can be accomplished through a variety of alternative instructional and assessment strategies. Information on adapting space and equipment for special needs students can be found in the Family and Consumer Sciences Facilities Guide available online at http://www.p12.nysed.gov/cte/facse/guide.html.

**10. How can teachers assess student achievement in Food Science?**

Students should be assessed on a regular basis. All students can demonstrate the acquisition of skills learned, and apply those skills to real-world situations, through:

- Authentic assessments
- Math computations
- Written reflections
- Tests and quizzes
- Public speaking
- Projects
- Portfolios
- Laboratories
- Scenarios

# Course: Food Science

Content Topics

**The Introduction to Food Science**

A. Food Science and Its Relevance to Global Society (FS)
B. Research Practices in Food Science (RP)
C. Concepts of Physical Sciences Relevant to Food Science (PS)
D. Concepts of Life Sciences Relevant to Food Science (LS)

**Food Biochemistry**

E. Water (W)
F. Carbohydrates (C)
G. Lipids (L)
H. Proteins (P)
I. Vitamins and Minerals (VM)

**Food Microbiology**

J. Introduction to Microorganisms (IM)
K. Microorganisms in Food Science (MFS)
L. Food Preservation (FP)
M. Food Safety (FS)

**The Future of Food Science**

N. Technological Advances in Food Science (TA)
O. Food Industry Careers (FIC)

**Appendices**

Appendix A - Chart Illustrating Science-Infused Curriculum
Appendix B - Suggested Laboratory Experiences
Appendix C - Learning Experience Template
Appendix D - Compilation of Performance Objectives and Supporting Competencies

## A. <u>Food Science and Its Relevance to Global Society (FS)</u> *How will I be able to understand basic concepts, history, and advancement of food science?*

### Standards Connections

**Food Science and Its Relevance to Global Society 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, 2 – Integrated Learning and 3a – Universal Foundation Skills; and NYS Science Standards HS-ESS3-1, HS-ESS3-3, HS-ESS3-5, and HS-ESS3-6**

### Rationale

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. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of 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-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

NYS Science HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

NYS Science HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

NYS Science HS-ESS3-6: Use a computational

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 scientists to the advancement of global food production
- FS.1.4. Explain the importance of studying food science

## B. <u>Research Practices in Food Science (RP)</u> *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

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.

### 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 Science 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.

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.

NYS Science HS-PS1-6 – Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

NYS Science HS-PS1-11 – Plan and conduct an investigation to compare properties and behaviors of acids and bases.

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 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. <u>Concepts of Physical Sciences Relevant to Food Science (PS)</u> *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 Standards 1 – Career Development, 2 – Integrated Learning and 3a – Universal Foundation Skills; and NYS Science Standards HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS1-10, HS-PS 1-11, HS-PS 1-12, HS-PS 2-6, and HS-LS1-7**

### Rationale

The purpose of this content topic is to understand those concepts of the physical sciences that are relevant to Food Science. Students will identify and classify elements, compounds and mixtures. Students will be able to identify chemicals, classify reactions, and understand factors that affect chemical reactions. Students will be able to identify examples of the various types of chemical reactions. Students will be able to explain concepts of energy and how it is used in food science. Students will be able to understand the processes of mechanical and physical separation and relate these to food science processes. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of food science.

### Key Ideas

NYS FACS 2 - Students can demonstrate the skills necessary to maintain their workplaces in a safe and comfortable condition. They can provide a safe and nurturing environment for themselves and others.

NYS Science HS-LS1-7 – Use a model to illustrate that aerobic cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

NYS Science HS-PS1-1 – Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

NYS Science 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.

NYS Science HS-PS1-3 – Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

NYS Science HS-PS 1-10 – Use evidence to support claims regarding the formation, properties, and behaviors of solutions at bulk scales.

NYS Science HS-PS1-11 – Plan and conduct an investigation to compare properties and behaviors of acids and bases.

NYS Science HS-PS-12 – Use evidence to illustrate that some chemical reactions involve the transfer of electrons as an energy conversion occurs within a system.

NYS Science HS-PS2-6 – Communicate scientific and technical information about why the particulate-level structure is important in the functioning of designed materials.

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 3a7 - Managing Resources
NYS CDOS 3a8 - Systems

**Performance Objectives and Supporting Competencies for Concepts of Physical Sciences Relevant to Food Science**

**Concepts of Physical Sciences Relevant to Food Science Performance Objective 1**

**PS.1 Identify and classify selected elements, interpret chemical symbols for elements, and describe atomic particles**

- PS.1.1. Classify elements into appropriate categories based on their properties
- PS.1.2. List subatomic particles
- PS.1.3. Identify elements by their chemical symbols
- PS.1.4. Explain properties characteristic of selected elements

**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

PS.2.2. Classify compounds into appropriate categories based on their types of bonding and properties

PS.2.3. List examples of compounds used in the home and in occupations

**Concepts of Physical Sciences Relevant to Food Science Performance Objective 3**

**PS.3 Distinguish between the different kinds of chemical reactions and understand the factors that effect them**

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. Explain the effect of factors on the rate of chemical reactions such as but not limited to temperature, pH, and energy

**Concepts of Physical Sciences Relevant to Food Science Performance Objective 4**

**PS.4 Define and classify mixtures based on their chemical properties**

PS.4.1. Classify mixtures into appropriate categories based on the distribution of particles

PS.4.2. List examples of mixtures used in the home and in occupations

PS.4.3. Explain the differences between compounds and mixtures

**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.5.1. Explain the various forms of energy such as but not limited to heat, light and electricity and understand the conversion from one form of energy to another
- PS.5.2. Recognize the various sources of energy
- PS.5.3. Identify and explain the relationship between potential and kinetic energy
- PS.5.4. Explain the concept of calories and temperature as measurements relevant to food science
- PS.5.5. Explain the ways energy flows and its relationship to food processes
- PS.5.6. Describe the relationship between energy and different phases of matter
- PS.5.7. Distinguish between endothermic and exothermic reactions
- PS.5.8. Explain the conditions that influence energy utilization in food preparation

**Concepts of Physical Sciences Relevant to Food Science Performance Objective 6**

**PS.6 Recognize the use of mechanical and chemical processes of separation in food science**

- PS.6.1. Recognize the process of mechanical separation based on physical properties such as but not limited to size and shape of particles
- PS.6.2. Recognize the processes of mechanical separation based on density such as but not limited to sedimentation and creaming
- PS.6.3. Recognize the processes of mechanical separation based on increased force such as but not limited to centrifuging and pressurization
- PS.6.4. Recognize the processes of chemical separation such as but not limited to distillation, evaporation, and crystallization
- PS.6.5. Recognize the process of selective separation using barriers such as filters and semi-permeable membranes

## D. <u>Concepts of Life Sciences Relevant to Food Science (LS)</u> *How will basic concepts of the life sciences help me understand Food Science?*

### Standards Connections

**Concepts of Life Sciences Relevant to Food Science 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, 2 – Integrated Learning and 3a – Universal Foundation Skills; and NYS Science HS-LS1-1, HS-LS1-2, and HS-LS1-3**

### Rationale

The purpose of this content topic is to understand those concepts of the life sciences that are relevant to food science. Students will identify metabolic reactions as either anabolism or catabolism. Students will understand the structure of the cell membrane and relate it to movement of substances into and out of cells. Students will understand the concept of homeostasis and its relationship to proper function in the human body. The students will understand the organization of life from cell to organ system and identify the functions of the various body systems. The students will understand the functions of the body systems as an integrated process. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of 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 can demonstrate the skills necessary to maintain their workplaces in a safe and comfortable condition. They can provide a safe and nurturing environment for themselves and others.

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-LS1-1 – Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

NYS Science HS-LS1-2 – Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

NYS Science HS-LS1-3 – Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

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 3a7 - Managing Resources
NYS CDOS 3a8 - Systems

**Performance Objectives and Supporting Competencies for Concepts of Life Sciences Relevant to Food Science**

**Concepts of Life Sciences Relevant to Food Science Performance Objective 1**

**LS.1 Explain the process of metabolism and relate to the body's utilization of nutrients; explain the organization of the human body and the factors controlling efficient functioning of the body**

- LS.1.1. Define metabolism and distinguish between anabolism and catabolism
- LS.1.2. Recognize the structure of biological membranes and its relationships to movement of substances into and out of cells
- LS.1.3. Recognize the process of diffusion and its relationship to osmosis and movement of substances across semi-permeable membranes
- LS.1.4. Explain the influence of pH on biological systems
- LS.1.5. Examine the relationship of variations in metabolic rate and factors such as but not limited to body types, nutrient intake and physical activity

**LS.2. Describe the levels of organization of life and the relationship to the human body**

- LS.2.1. Recognize the structure and functions of cells
- LS.2.2. Recognize the relationship among cells, tissues, organs, and organ systems with respect to the human body
- LS.2.3. Describe the basic functions of human body systems
- LS.2.4. Explain the integrated function of human body systems for maintenance of life
- LS.2.5. Recognize the importance of recommended dietary allowances and their effect on homeostasis for the efficient functioning of human body systems

## 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

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 body's requirements 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.

### 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-ESS2-5 – Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

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.

NYS Science HS-PS1-10 – Use evidence to support claims regarding the formation, properties, and behaviors of solutions at bulk scales.

NYS Science 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).

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. <u>Carbohydrates (C)</u> *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 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-LS1-6 and HS-LS2-3**

### Rationale

The purpose of this content topic is to study the properties of carbohydrates. Students will be able to define mono- and poly-saccharides and explain the body's method of digestion, absorption and assimilation of carbohydrates. Students will be able to explain the nature of several carbohydrate-related diseases such as diabetes and 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.

### 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-LS1-6 – Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements.

NYS Science HS-LS2-3 – Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

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 Carbohydrates**

**Carbohydrates Performance Objective 1**

**C.1 Analyze carbohydrates in food products, their role in the body, and implications for preparation of these food products**

- C.1.1. Identify the basic structure properties of carbohydrates
- C.1.2. Identify the dietary sources of carbohydrates
- C.1.3. Define mono-, di-, and poly- saccharides
- C.1.4. Identify the composition of starches
- C.1.5. Explain the ingestion, digestion, absorption, and use of carbohydrates in the human body
- C.1.6. Recognize diseases related to carbohydrate usage such as diabetes, hypoglycemia, and tooth decay
- C.1.7. Investigate advances in dietary carbohydrate management including, but not limited to, use of artificial sweeteners, and the concept of sugar alcohol
- C.1.8. Explain the functions of sugars in food preparations including, but not limited to, carmelization and crystallization
- C.1.9. Explain the functions of complex carbohydrates (starch) including, but not limited to, gelatinization and thickening processes
- C.1.10. Explain the sources and role of fiber in the diet

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

### Standards Connections

**Food Science Applications of Lipids 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-LS1-6 and HS-LS1-7.**

### Rationale

The purpose of this content topic is to study the properties of lipids. Students will be able to differentiate between saturated and unsaturated fats. Students will recognize Triglycerides, cis-, trans-, and omega fats and explain their impact on overall health. Students will be able to explain the five functions of fat including tenderizing, aeration, heat medium, emulsions, and flavorings. Students will explain the positive and negative roles of fats in the body and the implications for healthy hearts and weight control. Students will identify ways to reduce fat consumption through food preparation modifications. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of lipids 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 MST 1 - Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

NYS Science 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.

NYS Science HS-LS1-7 – Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

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 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 and 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. <u>Proteins (P)</u> *How can I analyze the properties and roles of protein in food science?*

**Standards Connections**

**Food Science Applications of Proteins 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 HS-LS1-1, HS-LS1-2, and HS-LS1-3**

### Rationale

The purpose of this content topic is to explore proteins, identify structure and nature of proteins and how these relate to functions of the body. Students will be able to define essential and non-essential amino acids and their sources. Students will be able to understand the processes of denaturation and coagulation and application to food preparation. Students will recognize the special features of proteins such as gelatinization and their roles in food preparation. Students will identify sources of plant and animal proteins. Students will demonstrate the impact of preparation methods on meat proteins, and identify analogs. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of protein 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-LS1-1 – Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

NYS Science HS-LS1-2 – Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

NYS Science HS-LS1-3 – Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

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 Proteins**

**Proteins Performance Objective 1**

**P.1 Analyze and understand the chemical composition of proteins and recognize the essential and non-essential amino acids and their sources**

- P.1.1. Identify the basic structure of amino acids and recognize their importance as building blocks of proteins
- P.1.2. Distinguish between essential and non-essential amino acids and their role in the body
- P.1.3. Relate protein shape to function in the body

**Proteins Performance Objective 2**

**P.2 Identify sources of proteins and understand the various forms of proteins and how they are utilized by the body**

- P.2.1. Identify sources of protein and their relative content
- P.2.2. Differentiate between complete, incomplete, and high quality protein and their relationship to vegetarian diets
- P.2.3. Describe the ingestion, digestion, absorption, and use of proteins in the human body
- P.2.4. Recognize conditions associated with protein deficiency
- P.2.5. Analyze the role of proteins as enzymes in regulating body metabolism

**Proteins Performance Objective 3**

**P.3 Recognize the changes that take place during the preparation of proteins, and identify protein analogs**

- P.3.1. Recognize causes 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. <u>Vitamins and Minerals (VM)</u> *How can I analyze the properties and roles of vitamins and minerals in food science?*

### Standards Connections

**Food Science Applications of Vitamins and Minerals 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 Standard HS-LS1-2**

### Rationale

The purpose of this content topic is to study the properties of vitamins and minerals. Students will describe fat and water soluble vitamins and their functions in the body. After reviewing a variety of vitamins and minerals, students will be able to distinguish between micro- and macro- minerals required for health, as well as their sources. Through investigation the students will identify deficiency and toxicity conditions associated with vitamins and minerals. Students will recognize the growing interest in phytochemicals that prevent various diseases. Students will recognize the need for nutrient retention as a goal of food preparation. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of vitamins and minerals 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-LS1-2 – Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

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 Vitamins and Minerals**

**Vitamins and Minerals Performance Objective 1**

**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

**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. <u>Introduction to Microorganisms (IM)</u> *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 Sciences 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

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.

### Key Ideas

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-LS2-2 – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales

NYS Science HS-LS2-6 – Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.

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

**Performance Objectives and Supporting Competencies for Introduction to Microorganisms**

**Introduction to Microorganisms Performance Objective 1**

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

IM.1.1. Recognize the general groups into which microorganisms are classified

IM.1.2. Distinguish bacteria based on shape, structure, temperature, and oxygen requirement

IM.1.3. Recognize general features and types of fungi

IM.1.4. Identify the various reproductive processes of bacteria, fungi, and other microorganisms

IM.1.5. Identify the factors that impact the growth of microorganisms

IM.1.6. Recognize the characteristics of microorganisms that are applicable to food science

## 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 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, 2 – Integrated Learning, 3a - Universal Foundation Skills and 3b – Career Majors; and NYS Science Standards HS-LS1-2, HS-LS2-1, HS-LS2-2, HS-PS1-5, and HS-PS1-6**

### Rationale

The purpose of this content topic is to identify useful and harmful microorganisms and their effects on food products. Students will be able to identify the different types of fermentation processes. Students will understand the changes in nutritional values of foods caused by microorganisms. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of specific microorganisms 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-LS1-2 – Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

NYS Science HS-LS2-1 – Use mathematical and/or computational representations to support explanations of biotic and abiotic factors that affect carrying capacity of ecosystems at different scales.

NYS Science HS-LS2-2 – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

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.

NYS Science HS-PS1-6 – Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at 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 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 Microorganisms in Food Science**

**Microorganisms in Food Science Performance Objective 1**

**MFS.1 Investigate useful microorganisms and their effects on food products**

- 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

**Microorganisms in Food Science Performance Objective 2**

**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 results in food intoxication

MFS.2.3. Identify and understand the metabolism of microbes that results in food infections

MFS.2.4. Identify the sources of microbial food contamination

## L. <u>Food Preservation (FP)</u> *How will I explain the concepts of food preservation as they relate to microorganisms and additives?*

### Standards Connections

**Food Preservation 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, 2 – Integrated Learning, 3a – Universal Foundation Skills and 3b – Career Majors; and NYS Science Standards HS-LS2-2, HS-LS2-7, HS-PS1-5, HS-PS1-10, and HS-PS3-1**

### Rationale

The purpose of this content topic is to understand concepts of food related to preservation. Students will identify methods of preventing food spoilage and their relationship to food safety. Students will explain the importance of additives in food. Students will describe the desirable and undesirable properties of food additives. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of food preservation strategies 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-LS2-2 – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

NYS Science HS-LS2-7 – Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

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.

NYS Science HS-PS1-10 – Use evidence to support claims regarding the formation, properties, and behaviors of solutions at bulk 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 the other 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 effect on food
- FP.1.6. Examine the procedural considerations for freezing various 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

**Food Preservation Performance Objective 2**

**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. <u>Food Safety (FS)</u>** *How will I explain the contamination of foods by non- microbial sources?*

## Standards Connections

**Food Safety 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, 2 – Integrated Learning, 3a – Universal Foundation Skills and 3b – Career Majors; and NYS Science Standards HS-LS1-2, HS-LS2-1, HS-LS2-2, HS-LS2-7, HS-PS1-5, and HS-PS1-10**

## Rationale

The purpose of this content topic is to understand sources of physical and chemical contamination in foods. Students will understand concepts of toxicity and bioaccumulation in foods. Students will demonstrate proper food handling techniques. Students will investigate government sanitation regulations in the food industry. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of non-microbial contaminants 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-LS1-2 – Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

NYS Science HS-LS2-1 – Use mathematical and/or computational representations to support explanations of biotic and abiotic factors that affect carrying capacity of ecosystems at different scales.

NYS Science HS-LS2-2 – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

NYS Science HS-LS2-7 – Design, evaluate, and refine a solution for reducing the impacts of human activities

on the environment and biodiversity.

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.

NYS Science HS-PS 1-10 – 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 - 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 Safety**

**Food Safety Performance Objective 1**

**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

**Food Safety Performance Objective 2**

**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. <u>Technological Advances in Food Science (TA)</u> *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 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, 2 – Integrated Learning and 3a – Universal Foundation Skills; and NYS Science Standards HS-LS1-8, HS-LS2-2, HS-LS2-7, and HS-PS3-1**

### Rationale

The purpose of this content topic is to exam 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 to 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 maintains continuity of life.

NYS Science HS-LS2-2 – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

NYS Science HS-LS2-7 – Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

NYS Science 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.

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

**Performance Objectives and Supporting Competencies for Technological Advances in Food Science**

**Technological Advances in Food Science Performance Objective 1**

**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) *How will I be able to increase my knowledge of career opportunities in the food industry?*

### Standards Connections

**Food Industry Careers supports the NYS Family and Consumer Sciences 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-ETS1-2, HS-ETS1-3, and HS-LS2-7**

### Rationale

The purpose of this content topic is to explore careers. Students will research, perform site visits or achieve experience through internships or apprenticeships in the food industry. Students will understand the necessary preparation required for specific careers in the food industry. This content topic will provide opportunities for students to apply communication, leadership, management, and thinking skills to the study of careers in the food industry.

### Key Ideas

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-ETS1-2 – Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

NYS Science HS-ETS1-3 – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

NYS Science HS-LS2-7 – Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

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

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| | workplace and other settings.<br><br><br><br><br>NYS CDOS 3a1 - Basic Skills<br>NYS CDOS 3a2 - Thinking Skills<br>NYS CDOS 3a3 - Personal Qualities<br>NYS CDOS 3a4 - Interpersonal Skills<br>NYS CDOS 3a5 - Technology<br>NYS CDOS 3a6 - Managing Information<br>NYS CDOS 3a7 - Managing Resources<br>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

## FOOD SCIENCE CORE

## CHART ILLUSTRATING SCIENCE-INFUSED CURRICULUM

| Family and Consumer Sciences Content Topics | NY CDOS Learning Standards and Key Ideas | NYS P12 Science Learning Standards (NGSS) | Sample Integrated Lab Activity (Appendix A) |
|---|---|---|---|
| **A. Food Science and It's Relevance to Global Society (FS)** | CDOS 1,2<br>CDOS 3a- Key Ideas 2, 3, 4, 6, 8 | HS-ESS3-1<br>HS-ESS3-3<br>HS-ESS3-5<br>HS-ESS3-6 | • Nutritional Main Meals and Global Issues<br>• Recognizing Sources of Vitamin C |
| **B. Research Practices in Food Science (RP)** | CDOS 1,2<br>CDOS 3a- Key Ideas 2, 3, 4, 6, 8 | HS-PS1-2<br>HS-PS1-5<br>HS-PS1-6<br>HS-PS1-11 | • Acidity of Foods<br>• The Effectiveness of Cleaning Products and Procedures on Microorganisms in the Home<br>• Fat and Water Content of Ground Meat Products<br>• Nutritional Main Meals and Global Issues<br>• Shortening Properties of Lipids in Pastry<br>• Recognizing Sources of Vitamin C |
| **C. Concepts of Physical Sciences Relevant to Food Sciences (PS)** | CDOS 1,2<br>CDOS 3a- Key Ideas 2, 3, 4,6, 7, 8 | HS-LS1-7<br>HS-PS1-1<br>HS-PS1-2<br>HS-PS1-3<br>HS-PS1-10<br>HS-PS1-11<br>HS-PS1-12<br>HS-PS2-6 | • Acidity of Foods<br>• Cheese Making<br>• Density Differences and Separations<br>• Effects of Salt on Boiling Point<br>• Gluten Development in Dough<br>• Oxidation of Foods<br>• Shortening Properties of Lipids in Pastry |
| **D. Concepts of Life Sciences Relevant to Food Science (LS)** | CDOS 1,2<br>CDOS 3a- Key Ideas 2, 3, 4, 6, 7, 8 | HS-LS1-1<br>HS-LS1-2<br>HS-LS1-3 | • Acidity of Foods<br>• Salt and Water Balance in Vegetables |
| **E. Water (W)** | CDOS 1, 2 | HS-ESS2-5<br>HS-PS1-5<br>HS-PS1-10<br>HS-PS3-4 | • Fat ad Water Content of Ground Meat Products<br>• Salt and Water Balance in Vegetables<br>• Water Content in Foods<br>• |

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| **F. Carbohydrates (C)** | CDOS 1, 2 | HS-LS1-6<br>HS-LS2-3 | • Nutritional Main Meals and Global Issues |
| **G. Lipids (L)** | CDOS 1,2 | HS-LS1-6<br>HS-LS1-7 | • Density Differences and Separations<br>• Fat and Water Content of Ground Meat Products<br>• Gluten Development in Dough, Nutritional Main Meals and Global Issues<br>• Shortening Properties of Lipids in Pastry |
| **H. Proteins (P)** | CDOS 1,2 | HS-LS1-1<br>HS-LS1-2<br>HS-LS1-3 | • Fat and Water Content of Ground Meat Products<br>• Gluten Development in Dough<br>• Nutritional Main Meals and Global Issues |
| **I. Vitamins and Minerals (VM)** | CDOS 1,2 | HS-LS1-2 | • Nutritional Main Meals and Global Issues<br>• Salt and Water Balance in Vegetables<br>• Recognizing Sources of Vitamin C |
| **J. Introduction to Microorganisms (IM)** | CDOS 1, 2<br>CDOS 3a- Key Ideas 1, 2, 3, 4, 5, 6, 7, 8 | HS-LS2-2<br>HS-LS2-6 | • The Effectiveness of Cleaning Products and Procedures<br>on Microorganisms in the Home |
| **K. Microorganisms in Food Science (MFS)** | CDOS 1, 2<br>CDOS 3a – Key ideas 1, 2, 3, 4, 5, 6, 7, 8,<br>CDOS 3b – Human and Public Service | HS-LS1-2<br>HS-LS2-1<br>HS-LS2-2<br>HS-PS1-5<br>HS-PS1-6 | • Canning of Simple Items, Cheese Making<br>• The Effectiveness of Cleaning Products and Procedures on Microorganisms in the Home |
| **L. Food Preservation (FP)** | CDOS 1, 2,<br>CDOS 3a- Key Ideas 1, 2, 3, 4, 5, 6, 7, 8<br>CDOS 3b – Human and Public Service | HS-LS2-2<br>HS-LS2-7<br>HS-PS1-5<br>HS-PS1-10<br>HS-PS3-1 | • Canning of Simple Items<br>• Grocery Store Visit |

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| **M. Food Safety (FS)** | CDOS 1, 2, CDOS 3a- Key Ideas 1, 2, 3, 4, 5, 6, 7, 8 CDOS 3b – Human and Public Service | HS-LS1-2 HS-LS2-1 HS-LS2-2 HS-LS2-7 HS-PS1-5 HS-PS1-10 | • Canning of Simple Items • Nutritional Main Meals and Global Issues |
| **N. Technological Advances in Food Science (TA)** | CDOS 1, 2, CDOS 3a- Key Ideas 1, 2, 3, 4, 5, 6, 7, 8 | HS-LS1-8 HS-LS2-2 HS-LS2-7 HS-PS3-1 | • Product Production and Presentation |
| **O. Food Industry Careers (FIC)** | CDOS 1, 2, CDOS 3a- Key Ideas 1, 2, 3, 4, 5, 6, 7, 8 | HS-ETS1-2 HS-ETS1-3 HS-LS2-7 | • Grocery Store Visit • Product Production and Presentation |

# Appendix B

## Suggested Laboratory Experiences for Food Science

Food Science is a Family and Consumer Sciences foods and nutrition cluster-level 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 third-year 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 a hands-on, experiential approach to learning. Each of the following laboratories is connected to the objectives and supporting competencies in Food Science:

- Acidity of Foods
- Canning of Simple Items
- Cheese Making
- Density Differences and Separations
- Effectiveness of Cleaning Products and Procedures on Microorganisms
- Effects of Salt on Boiling Point
- Fat and Water Content of Ground Meat Products
- Gluten Development in Dough
- Grocery Store Visit
- Nutritional Main Meals and Global Issues
- Oxidation of Foods
- Product Production and Presentation
- Salt and Water Balance in Vegetables
- Shortening Properties of Lipids in Pastry
- Vitamin C in Fruits and Vegetables
- Water Content in Foods
- Student laboratory Form

## 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 research. 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 their 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 person's stomach acid is somewhere in the 3 to 4 range.

Foods such as pasta sauce, fruit 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 of ulcerations (stomach/esophagus), inflammations, and cancers associated with high digestive acid levels.

## Canning of Simple Items

**Content Connections:**
Food Microbiology
K. Microorganisms in food science (MFS)
L. Food Preservation (FP)
M. Food Safety (FS)

**Objectives:**
Students will gain the understanding of clean kitchen practices by preparing foods for canning. Students will practice sterilization process. Students will measure the proper temperatures that ensure a safe jellied product. Students will diagram the steps needed to can fruits and vegetables. Students will complete process to can fruits and vegetables utilizing a non-pressure cooking technique. Students will sample their creations and evaluate how the process could be improved.

**Materials:**
Recommended resource - Ball-Blue Book of Preserving, ISBN # 0-9727537-0-2 Jarden Home Brands, Consumer Department, PO Box 2729, Muncie, IN 47307 - 0729
Common fruits or vegetables that are easy to prepare and can
Sugar
Pectin (Sure-Jell)
Pint size canning jars, lids, and rims
Large steaming pot or canner
Cooking thermometer

**Procedure:**
Students will take class time to review the steps in simple canning process. Sterilization process utilizing a non-pressure canner will be practiced prior to canning. Preparation of fruit or vegetables will be conducted before canning.
Studying the techniques will be conducted before activity.

**Extensions:**
Research the history of canning and pasteurization
Estimations will be made to the shelf life of the product they have produced
Jams or pickled products will be sampled by the class as the course comes to a close

## 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 and 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, rennilase, 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 rennilase enzyme)
Cheese cloth (to separate the whey from curd)
Set of large spoons
Colander
Set of measuring cups
Variety of milks
Set of glass (non-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 the 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 overnight clabbering 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 capsule, curdling enzyme and enough materials to use in a class of 30 students.

**Extensions:**
During yogurt making, watch the separation
Allow students to use a variety of milks (1%, 2%, whole, chocolate) and then speed things up with the 1% molar hydrochloric acid solution.

## Density Differences and Separations

**Content Connections:**
The Introduction to Food Science
C. Concepts of Physical Sciences Relevant to Food Science (PS)
Food Biochemistry
G. Lipids (L)

**Objective:**
To observe and effectively separate liquids and foods utilizing separation due to density differences. Predict the outcome of two substances with unknown densities, and calculate them.

**Materials:**
Large eggs
Red Wine vinegar
Olive oil
Chicken stock
Saran or plastic wrap
Wire ties
Digital scale or triple beam balance
Metric calibrated clear measuring cup(s)

**Procedure:**

**First Section**
A group of three students will receive one large egg. The egg's density will be determined by weighing the egg, using a water displacement method (dropping egg into clear measuring cup to determine the amount of milliliters displaced) to determine volume, and then subtracting the mass of the shell after the egg has been emptied.

$$\text{Density} = \text{Mass}/\text{Volume}$$

The egg white will then be separated from the yolk using an egg separator or the shell. As the egg is being separated each part should be isolated into or onto a 5 in. by 5 in. sheet of plastic wrap. Once isolated each should be wrapped and tied. The separated egg section's density will be weighed and submerged to find out the yolk vs. the white density. Finally, the mass of tie and plastic wrap will be subtracted. Discussion can be generated on which will be less dense than water. Nutrition of each part as well as allergies can be discussed.

**Second Section**

**Materials:**
Glass 6 oz. containers or canning jars.
A variety of oils, (i.e. canola, olive, corn, peanut, etc.)
A variety of vinegars (i.e. white, apple cider, balsamic, etc.)
A variety of herbs and spices

Students in the same group will be timing how long it takes various types of vinegars and oils 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 serving 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 the 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 or spun 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 creation stick to 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 "clean" the sections under different methods they have chosen to apply, trying to replicate 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 entire 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

from the recently cleaned grid section to swab the prepared Petri dish. Repeat with different cleansers in a different grid section. Allow the samples to set at room temperature for several days or until a culture grows.

*For variations*, wipe a grid section with a sponge dampened with tap water, only; with a cloth dipped in a basin filled with water and dish detergent. Make your own household cleanser using ammonia and water; alcohol and water; household cleansers purchased in concentrate, and diluted with water. Have students use one cleanser only, but allow it to remain on the grid sections for different amounts of time (one minute, two minutes, three minutes, etc.) before wiping with a paper towel.

**Extensions:**
Have students take a poll of the student body about their practices for household cleanliness.
Have students research restaurant health codes for New York State.
Have students research local incidences of health code violations in restaurants and discuss what cleaning practices the food establishment could have implemented.

## 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 salt has on boiling point temperatures

**Materials**:
Variety of salts (i.e. iodized and non-iodized, 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 measurements in 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 could be 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 city of Denver, CO requires only a 206º F and in Lake Tahoe water boils at 202º F. 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 .9º F for every 500 feet.

Some students might research the health aspects of non-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 lost is water. Students will also compare taste and juiciness of burgers from each ground meat product 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 variation. 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 $74^0$C ($165^0$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 cool 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 on-line nutrient analysis, research the water and fat content of various meat products, such as hot dogs, and determine the relationship between fat content and water content in these products.
Research food issues related to meat consumption and compare to plant sources of protein in terms of health, cost, food safety issues, and protein content.

## Gluten Development in Dough

**Content Connections:**
Food Biochemistry
- F. Carbohydrates (C)
- G. Lipids (L)
- H. Proteins (P)

**Objectives:**
Students will learn that gluten ingredients are the main ingredient in baked goods because its elasticity allows gases to be trapped inside, giving a lighter structure to the baked product. Students will prepare two doughs, one containing the assigned flour with fat, and one containing the assigned flour without fat. Students will observe characteristics of the two doughs and explain the effect of working the dough, as well as the effect fat has on gluten development. Students will compare various flours and compare gluten development, concluding which flour contains the most gluten.

**Materials:**
Balance
Graduated cylinder
String
Scissors
16 g assigned flour for each group (i.e., bread, all-purpose, cake, whole wheat, gluten-free)
12 g shortening
2 bowls
Wooden spoon
Water (about 30 ml per sample)
Fork
Metric ruler

**Procedure:**
Student lab groups will prepare dough, using their assigned their flour variation. Students will blend 12 g shortening and 8 g assigned flour with a fork, adding enough water to hold the dough together. Students will prepare second dough using 8 g assigned flour and enough water to hold the dough together. Students will shape their two dough samples into uniform length tube-shaped rolls. Students will hold each end of the dough tube and pull along the length of a string. Cutting each string at the length at which the dough breaks, students will measure the length of each string. Taking the dough with only flour and water, students will work and knead it for 3 minutes. Students will shape it into a tube and stretch it along a length of string, cutting and measuring the string. Students will work and knead the same dough for another 3 minutes, and repeat the measurement process. Students will compare results with other student lab groups using other flours.

**Extensions:**
Research health conditions as they relate to wheat consumption and wheat 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 rest of 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 packing and processing foods. Students will locate resources to research food industry jobs.

**Procedure**:
The teacher should create a check list 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.

## Nutritional Main Meals and Global Issues

**Content Connections:**
The Introduction to Food Science
- A. Food Science and Its Relevance to Global Society (FS)
- B. Research Practices in Food Science (RP)

Food Biochemistry
- F. Carbohydrates (C)
- G. Lipids (L)
- H. Proteins (P)
- I. Vitamins and Minerals (VM)

Food Microbiology
- M. Food Safety (FS)

**Objectives:**
Students will evaluate and compare the nutrient content, cost, and number of servings for meals when the main course ingredient is one pound of ground beef; dried beans and rice (1/2 pound each); tofu; quinoa; and farm-raised fresh salmon.

**Materials:**
List of protein "main dish" ingredient
Advance time for students to go to grocery store to obtain cost per pound
Computer time and internet access (class period reservation in school library)
Access to printer

**Procedure:**
Student lab groups will be research the cost and availability of one pound of each ingredient in the local supermarket. Using the USDA on-line database, students will identify the nutrient contributions of said ingredient (carbohydrate, protein, fat, vitamins, minerals and water) and record this information for each main-course ingredient. Search the USDA data-base for reported incidences of food recalls for each ingredient.

**Extensions:**
Research the health benefits of a vegetarian diet vs. a diet rich in protein from animal sources.
Research the reported incidences of food borne illnesses and food contamination in foods of animal sources vs. foods of plant sources in the last two years.
Research the environmental and economic issues of *farm-raised* fish.
Research the availability of each ingredient worldwide, and how it is grown or harvested; analyze the environmental issues surrounding each food, and its sustainability as a world crop.

## Oxidation of Foods

**Content Connections:**
Introduction of Food Science
C. Concepts of Physical Sciences Relevant to Food Science (PS)

**Objectives:**
Students will be able to describe the nature of decomposition reactions and recognize examples of this type of reaction

**Materials:**
Variety of fruits: apples, pears, peaches, pineapple, light colored melon, bananas and avocado
Lemon juice

**Procedure:**
Food preparation includes how well the food can be stored and kept fresh as possible. Oxidation of foods causes them to dry out, discolor (meats) and to brown (fruits and vegetables). Observe how quickly various food items prepared under the same conditions will brown or oxidize.

Fruit is the easiest to prepare and visually watch for change. Some examples will be apples, pears, peaches, pineapple, light colored melon, bananas, and avocado. Students will cut pieces close in size and shape so as to keep surface area relatively uniform. Each student will record the time the piece was cut and when it appears to become brown.

A second group can prepare the same fruit varieties but dip their fruit pieces in lemon juice. Observe how long it takes before the oxidizing occurs.

Data should be collected and analyzed. Leading questions should also be generated. Which fruit lasted the longest? Why? How well did the lemon juice prevent oxidation? Did the lemon juice also kill or prevent bacteria from digesting the fruit's surface?

**Extensions:**
Use of sugar and water sprays to prevent oxidation.

## 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 peers. A question and answer session could culminate the presentation.

**Project Outline:**
Student groups will present a product idea.
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:

- Inspiration for the food product (health, nutritional, new market, diet / exercise)
- Research aspects (Is this a new product or one that is improved from an existing?)
- Ingredient research (What will go into your product and how will it be tested?)
- Health benefit / risks (documented study or ingredient breakdown)
- Packaging run down (How and what type of materials in product and packaging?)
- Shipping proposal (small to large production, by rail, road, air, local, etc.)
- Cost research (How much to produce, package, ship product vs. consumer product price?)
- 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)
Food Biochemistry
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, or sliced 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, tomato 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 monosodium 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 Sciences 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, lard, 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-sized square on an aluminum foil covered cookie sheet, cutting it into an equal amount of squares before baking.
After baking, each student lab group will stack an equal number of the pastry squares and measure the height of the pastry stack.
Students will conduct a sensory evaluation of the remaining pastry samples.
Students will determine which lipid has the best shortening qualities as well as discuss which lipid might be best for various baked goods.

**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 their 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

**Content Connections:**
Intro to Food Science
- A. Food Science and Its Relevance to Global Society (GS)
- B. Research Practices in Food Science (RP)

Food Biochemistry
- I. Vitamins and Minerals (VM)

**Objectives:**
Students will identify the presence of Vitamin C in a variety of fruits and vegetables.

**Materials:**
Tap Water
Cornstarch
Iodine
Liquid measuring cup
Measuring spoons
Blender
Mixing bowls
Mixing spoons
Knives
Cutting boards
Access to stove or burner
Tea kettle (to boil water)
Spoons or stirrers
Fresh fruits and vegetables ***and/or*** fruit and vegetable juice

**Procedure:**
Have students prepare an acid indicator of one teaspoon cornstarch dissolved in 1 cup of boiling water, set aside to cool for fifteen minutes. Add drops of iodine while stirring the cornstarch mixture until the mixture turns blue. This is the Vitamin C indicator. Place small amounts (about 1 teaspoon) of the indicator into clear glass test tubes or small drinking glasses or clear jars.

Meanwhile, extract juices from the various fruits and vegetables obtained. Either squeeze the juice, or mash the produce until there is juice to collect. You may have students pulse some fruits or vegetables in a blender. Using an eye dropper, slowly add the fruit or vegetable juice, one drop at a time, until the indicator is no longer blue. Have students record how many drops were necessary.

The higher the concentration of Vitamin C, the *fewer* drops of produce juice needed to make the blue color of the indicator disappear.

**Extensions:**
Research Hypo- and Hyper-vitaminosis and the diseases related to vitamin deficiency and excessive amounts.
Research how Food Scientists determined the minimum recommended dietary allowances for vitamins.
Research the effect of various lifestyle choices and health conditions on the body's ability to 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 gms. (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 should 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 can also 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 created as well as comparing the groups' 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 may 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 Procedure:**

**Hypothesis:**
If, then statement

**Calculations:**

**Observations:**

**Data Reporting:**
Table, chart or graph

**Questions:**

Answer any questions the teacher has included for this laboratory

**Conclusion:**

This section of the laboratory report is where observations are discussed with respect to the objectives of the lab. You may want to start your conclusion with a phrase like "From this lab I learned…." or "I would like to know more about…."

**Recommendations:**

This section of your laboratory is where you discuss any extension activity you have done as recommended by this experiment. You may also recommend ways in which you and your lab partner could have achieved more accurate results with regard to laboratory procedure. You may state "To get more accurate results we could have…."
Further research suggestions can be included here.

# Appendix C

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

| Indicators | 1<br>Falls Below Expectations | 2<br>Approaches Expectations | 3<br>Meets Expectations | 4<br>Exceeds Expectations |
|---|---|---|---|---|
| **NYS FACS Learning Standards** | Does not connect to NYS FACS Learning Standards. | Has limited evidence of connection to 1 NYS FACS Learning Standard. | Adequate evidence of connection to 1 or more NYS FACS Learning Standards. | Evidence of strong connections to 2 or more NYS FACS Learning Standards |
| **NYS CDOS Learning Standards** | Does not connect to NYS CDOS Learning Standards. | Has limited evidence of connection to 1 NYS CDOS Learning Standard. | Adequate evidence of connection to 1 or more NYS CDOS Learning Standard including Standard 3b. | Evidence of strong connections to 2 or more NYS CDOS Learning Standards including Standard 3b. |
| **NYS P-12 Science Standards and NYS academic Learning Standards** | Does not connect to NYS P-12 Science Standards, or other NYS academic Learning Standards. | Has limited evidence of connection to NYS P-12 Science Standards, or to 1 NYS academic Learning Standard. | Adequate evidence of connection NYS P-12 Science Standards and to 1 or more NYS academic Learning Standard. | Evidence of strong connections to NYS P-12 Science Standards and to 1 or more NYS academic Learning Standard. |
| **Course Content Topics** | Does not relate to Content Topics. | Addresses 1 Content Topic. | Integrates 2 Content Topics. | Integrates 3 or more Content Topics. |
| **Strategy** | Instruction is dependent primarily on textbooks, lecture, paper, and pencil. Teacher driven. | Hands-on experiential learning is limited. Minimal student involvement. | Includes 75 percent hands-on experiential learning. Adequate student involvement. | Includes more than 75 percent hands-on experiential learning. Active student engagement. Teacher as facilitator. |
| **Implementation** | Does not flow in a logical sequence. Necessary resources would make implementation difficult. | Follows a logical sequence. Most necessary resources may make implementation difficult. | Follows a logical sequence. Some necessary resources may make implementation difficult. | Follows a logical sequence. All necessary resources make implementation easy. |
| **Assessment** | Cannot be assessed.<br>Or<br>Assessment not included. | Assessment is vaguely related to objectives and competencies. | Assessment relates to objectives and competencies. | Assessment is directly related to objectives and competencies. |

| **PLANNING** | | | |
|---|---|---|---|
| Curriculum Goal | | | |
| Essential Question(s) | | | |
| National Standards | | | |
| NYS Standards | | | |
| Learning Objectives | | | |
| Vocabulary | Academic | Content | |
| Materials and Resources | | | |
| **INSTRUCTION** | What will the teacher do? | What will the students do? | How much time for each activity? |
| Pre-assessment | | | |
| Do-now/Hook | | | |
| Procedure for Instruction/ Learning Activities | | | |
| Differentiation | | | |
| Closure | | | |
| **ASSESSMENT** | | | |
| Academic Skills | | | |
| Technical Skills | | | |
| Employability Skills (Life/Career Abilities) | See Life/Career Abilities Rubric Tool at https://nyctecenter.org/instruction/life-career-abilities | | |

# Appendix D

## FOOD SCIENCE
## PERFORMANCE OBJECTIVES AND SUPPORTING COMPETENCIES

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

**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 scientists to the advancement of global food production
- FS.1.4. Explain the importance of studying food science

**B. Research Practices in Food Science (RP)**

**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)**

**PS.1 Identify and classify selected elements and interpret chemical symbols for elements, and describe atomic particles**

- PS.1.1. Classify elements into appropriate categories based on their properties
- PS.1.2. List subatomic particles
- PS.1.3. Identify elements by their chemical symbols
- PS.1.4. Explain properties characteristic of selected elements

**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
- PS.2.2. Classify compounds into appropriate categories based on their types of bonding and properties
- PS.2.3. List examples of compounds used in the home and in occupations

**PS.3 Distinguish between the different kinds of chemical reactions and understand the factors that effect them**

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. Explain the effect of factors on the rate of chemical reactions such as but not limited to temperature, pH, and energy

**PS.4 Define and classify mixtures based on their chemical properties**

PS.4.1. Classify mixtures into appropriate categories based on the distribution of particles
PS.4.2. List examples of mixtures used in the home and in occupations
PS.4.3. Explain the difference between compounds and mixtures

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

PS.5.1. Explain the various forms of energy such as but not limited to heat, light and electricity and understand the conversion from one form of energy to another
PS.5.2. Recognize the various sources of energy
PS.5.3. Identify and explain the relationship between potential and kinetic energy
PS.5.4. Explain the concept of calories and temperature as measurements relevant to food science
PS.5.5. Explain the ways energy flows and its relationship to food processes
PS.5.6. Describe the relationship between energy and different phases of matter
PS.5.7. Distinguish between endothermic and exothermic reactions
PS.5.8. Explain the conditions that influence energy utilization in food preparation

**PS.6 Recognize the use of mechanical and chemical processes of separation in food science**

PS.6.1. Recognize the process of mechanical separation based on physical properties such as but not limited to size and shape of particles
PS.6.2. Recognize the processes of mechanical separation based on density such as but not limited to sedimentation and creaming
PS.6.3. Recognize the processes of mechanical separation based on increased force such as but not limited to centrifuging and pressurization
PS.6.4. Recognize the processes of chemical separation such as but not limited to distillation, evaporation, and crystallization
PS.6.5. Recognize the process of selective separation using barriers such as filters and semi-permeable membranes

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

**LS.1 Explain the process of metabolism and relate it to the body's utilization of nutrients; explain the organization of the human body and the factors controlling efficient functioning of the body**

- LS.1.1. Define metabolism and distinguish between anabolism and catabolism
- LS.1.2. Recognize the structure of biological membranes and its relationship to the movement of substances into and out of cells
- LS.1.3. Recognize the process of diffusion and its relationship to osmosis and movement of substances across semi-permeable membranes
- LS.1.4. Explain the influence of pH on biological systems
- LS.1.5. Examine the relationship of variations in metabolic rate and factors such as but not limited to body types, nutrient intake and physical activity

**LS.2. Describe the levels of organization of life and the relationship to the human body**

- LS.2.1. Recognize the structure and function of the cell
- LS.2.2. Recognize the relationship among cells, tissues, organs, and organ systems with respect to the human body
- LS.2.3. Describe the basic functions of human body systems
- LS.2.4. Explain the integrated function of human body systems for maintenance of life
- LS.2.5. Recognize the importance of recommended dietary allowances and their effect on homeostasis for efficient functioning of human body systems

**E. Water (W)**

**W.1 Analyze and describe 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 point 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)**

**C.1 Analyze carbohydrates in food products, their role in the body, and implications for preparation of these food products**

- C.1.1. Identify the basic structure properties of carbohydrates
- C.1.2. Identify the dietary sources of carbohydrates
- C.1.3. Define mono-, di-, and poly- saccharides
- C.1.4. Identify the composition of starches
- C.1.5. Explain the ingestion, digestion, absorption, and use of carbohydrates in the human body
- C.1.6. Recognize diseases related to carbohydrates such as diabetes, hypoglycemia, and tooth decay

C.1.7. Investigate advances in dietary carbohydrate management including, but not limited to, use of artificial sweeteners, and the concept of sugar alcohol

C.1.8. Explain the functions of sugars in food preparations including, but not limited to, carmelization and crystallization

C.1.9. Explain the functions of complex carbohydrates (starch) including, but not limited to, gelatinization, thickening processes

C.1.10. Explain the sources and role of fiber in the diet

**G. Lipids (L)**

**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, obesity and 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)**

**P.1 Analyze and understand the chemical composition of proteins and recognize the essential and non essential amino acids and their sources**

P.1.1. Identify the basic structure of amino acids and recognize their importance as building blocks of proteins

P.1.2. Distinguish between essential and non-essential amino acids and their role in the body

P.1.3. Relate protein shape to function in the body

**P.2 Identify sources of proteins and understand the various forms of proteins and how they are utilized by the body**

P.2.1. Identify sources of protein and their relative content

P.2.2. Differentiate between complete, incomplete, and high quality proteins and their relationship to vegetarian diets

P.2.3. Describe the ingestion, digestion, absorption, and use of proteins in the human body

P.2.4. Recognize conditions associated with protein deficiency

P.2.5. Analyze the role of proteins as enzymes in regulating metabolism

**P.3 Recognize the changes that take place during the preparation of proteins and identify protein analogs**

- P.3.1. Recognize causes 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**

- IM.1.1. Recognize the general groups into which microorganisms are classified
- IM.1.2. Identify bacteria based on shape, structure, temperature, and oxygen requirement
- IM.1.3. Recognize general features and types of fungi
- IM.1.4. Identify the various reproductive processes of bacteria, fungi, and other microorganisms
- IM.1.5. Identify the factors that impact the growth of microorganisms
- IM.1.6. Recognize the characteristics of microorganisms that are applicable to food science

## K. Microorganisms in Food Science (MFS)

**MFS.1 Investigate useful microorganisms and their effects on food products**

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 results in food intoxication
MFS.2.3. Identify and understand the metabolism of microbes that results 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 effect on food
FP.1.6. Examine the procedural considerations for freezing various 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