



From "STEM" to Plate:

Careers in Food Science

Grades 6-8

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California Foundation for Agriculture in the Classroom

Vision: An appreciation of agriculture by all.

Mission: To increase awareness and understanding of agriculture among California's educators and students.



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Unit Overview

Unit Length

Four lessons of varying length

Objectives

Students will:

- ▶ Create and refine a recipe for a new food product.
- ▶ Calculate the rates of profit for a new food product.
- ▶ Learn how to identify the needs and desires of consumers.
- ▶ Learn how to determine the nutritional value of recipes.
- ▶ Identify the necessary materials and design packaging for a new food product.
- ▶ Learn the characteristics of effective packaging.
- ▶ Learn that packaging a product involves science, engineering, technology, and math.
- ▶ Identify the growing regions of an agricultural commodity.
- ▶ Design a process for distributing California-grown agriculture products throughout the state.
- ▶ Learn why a commodity is grown in a specific region.

Brief description

This four-lesson unit for grades six through eight promotes the development of STEM abilities and critical thinking skills, while fostering an appreciation for the people involved in food production. The new curriculum includes inquiry-based labs, real life challenges for students to investigate and opportunities to plan and construct products and shipping models. Featured careers include food scientist, food packaging specialist, food transportation specialist, and food safety specialist.

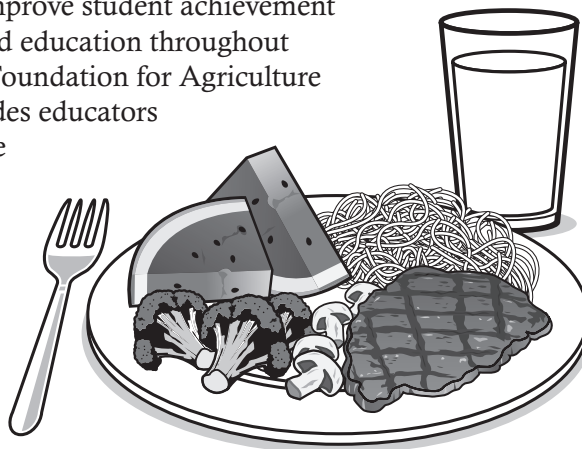
The lessons can be used separately or together and may be taught in any order. To fully address the concepts, it is recommended that the unit be taught in its entirety.

California Standards

A concerted effort to improve student achievement in all areas has impacted education throughout California. California Foundation for Agriculture in the Classroom provides educators with numerous resource materials and lessons that can be used to teach and reinforce the current education standards for California Public Schools, including Common Core State Standards, Next Generation

Science Standards, and Content Standards. The lessons encourage students to think for themselves, ask questions, and learn problem-solving skills while learning the specific content needed to better understand the world in which they live.

This unit, *From “STEM” to Plate: Careers in Food Science*, includes lessons that can be used to teach and reinforce many of the educational content standards covered in grades six through eight. The purpose of the unit is to strengthen STEM and Common Core skills while introducing students to careers in agriculture. A matrix chart with detailed information on the alignment of each lesson with State Standards is included on page 61.



Unit Overview

- ▶ Learn how to prevent foodborne illness through safe food handling and preparation.
- ▶ Learn how environmental factors influence bacterial growth.
- ▶ Design an experiment to test a hypothesis.
- ▶ Identify different types of bacterial pathogens that can lead to foodborne illnesses.

California Standards

Standards alignment is listed in the matrix on page 61.

Evaluation

This unit incorporates numerous activities, questions, presentations, and rubrics that can be used as evaluation tools. With an emphasis on student inquiry, few of these lessons have right or wrong answers, rather they engage students in thinking critically about their learning experience and applying what they learn to real-life experiences.

Mix It Up!

Food Scientist

Purpose

In this lesson, students will model the responsibilities of a food scientist by working in product development teams to create a new food product. Tasks will involve market analysis, economics, food chemistry and safety, graphic design, and communication.

Time

Five 50-minute class periods

Materials

For the teacher:

- ▶ *Project Grading Rubric* (page 11)

For the students:

- ▶ *Product Development Team* handouts (pages 12-17)
- ▶ One base ingredient for trail mix such as cereals, nuts, pretzels, etc. Beware of food allergies when selecting ingredients.
- ▶ Water
- ▶ Small paper cups for taste testing
- ▶ Plastic spoons
- ▶ Labels
- ▶ Waterproof markers
- ▶ Refrigeration

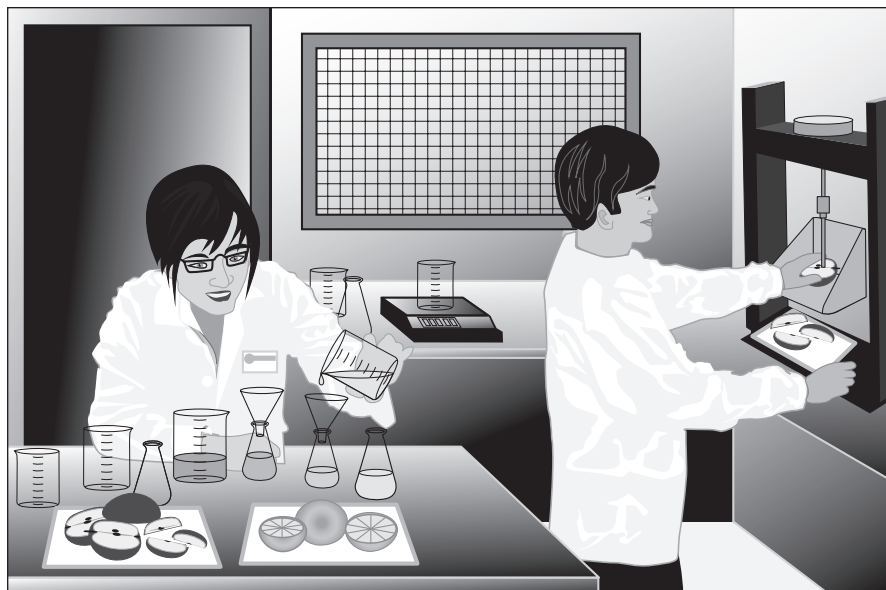
Background Information

Food scientists study the physical characteristics, microbiology, and chemistry of the food we eat every day in order to develop and improve methods for preservation, quality control, nutrition, safety, sustainability, and convenience.

Food scientists work in teams with colleagues who specialize in specific areas such as research, packaging, nutrition analysis, product safety, clinical trials, world hunger challenges, and more. Many opportunities exist for careers in food science. Even Disney and NASA employ food scientists!

Government organizations such as the Food and Drug Administration work with food scientists to ensure that food on grocery store shelves meets health codes and is safe to eat. Strict protocols are enforced for food testing, manufacturing, transportation, storage, and expiration dates.

The demand for food scientists is increasing in response to the challenge of providing safe, nutritious, and flavorful food for the world's growing population. Many colleges offer food science programs that include courses in life science and physical science, food law, food microbiology, food processing and nutrition, foreign languages, communications, and more.



Mix It Up!

Food Scientist

- ▶ Kitchen scale
- ▶ Internet access

Provided by groups based on interest:

- ▶ Crackers, cereals, nuts, spices, chocolate, dried fruit, pretzels, etc.
- ▶ Resealable plastic bags or containers
- ▶ Sterilized measuring cups, spoons, mixing bowls

California Standards

Standards alignment is listed in the matrix on page 61.

Grade 6

Common Core English Language Arts

RST.6.3
SL.6.1, 6.2, 6.3, 6.5
W.6.1, 6.2
WHST.6.6, 6.7, 6.8

Common Core Mathematics 6.EE.2c

Next Generation Science Standards

MS-ETS1.B, MS-ETS1.C

Visual and Performing Arts Content Standards Aesthetic Valuing 4.3

Grade 7

Common Core English Language Arts RST.7.3

Procedure

1. Bring an item to class, such as a box of cereal or sports drink and ask students for ideas on how an item like this can transform from an idea to a selection on our grocery store shelves.
2. Introduce students to a day in the life of a food scientist by viewing a few of the videos found on the Institute of Food Technologists website. Begin by viewing the link *What is Food Science & Technology?* to see a three minute video clip: www.ift.org/knowledge-center/learn-about-food-science/what-is-food-science.aspx. Follow up by viewing short video clips under the “Day in the life of a food scientist” link.
3. Another exciting example of developments in food science comes from a food scientist named Elizabeth Fenner who used micro-encapsulation to create a “flavor release” ice cream that starts out as vanilla at first taste then transforms into cherry before you swallow it. A short video clip may be viewed on online by searching for “The Next Generation of Ice Cream: One Bite, Two Flavors.”
4. Tell students that, in this lesson they will act as food scientists working on a product development team to create a winning new trail mix. Each team member will specialize in a certain area such as marketing, food chemistry, graphic design, and cost analysis. Encourage students to feature California grown crops in their recipes. At the end of the assignment teams will present their products to the class, and will finally eat their science experiments!
5. Organize students into teams of four and distribute the *Product Development Team* handouts. As a class, discuss the details of each task and the importance of communication between team members to meet the overall goal of creating a successful new product. Display the project grading rubric for the class to see and discuss. Instruct any students with food allergies to notify the teacher of specific restrictions. Students in each team should share task responsibilities in order to provide all students with an opportunity to experience different aspects of product development.
6. Provide one class period for students to conduct research and design their plan of action. Before the end of class, the teacher should receive and approve an outline from each team showing a written timeline of steps to complete the project on time.

Mix It Up!

Food Scientist

California Standards (cont.)

Grade 7 (cont.)

SL.7.1, 7.2, 7.5
W.7.1, 7.2
WHST.7.6, 7.7, 7.8

Common Core Mathematics 7.RP.3

Next Generation Science Standards

MS-ETS1.B
MS-ETS1.C

Visual and Performing Arts Content Standards Aesthetic Valuing 4.4

Grade 8

Common Core English Language Arts

RST.8.3
SL.8.1, 8.2, 8.5
W.8.1, 8.2
WHST.8.6, 8.7, 8.8

Next Generation Science Standards

MS-ETS1.B
MS-ETS1.C

Visual and Performing Arts Content Standards

Aesthetic Valuing 4.4
Connections, Relationships,
Applications 5.3

- ▶ For homework, each team should conduct a survey to identify favorite trail mix ingredients amongst their target audience. As a class, decide upon the appropriate number of people to survey. Teams may conduct the survey through social media, paper and pencil, or other appropriate methods.
 - ▶ After the survey results are in, each team should gather the preferred ingredients and tools they will need to prepare three slightly different versions of the trail mix recipe and carry out a taste test the next day in class.
7. Prior to any food preparation, ensure that cooking areas, utensils, and cookware are sanitized and that students have washed their hands. Perishable food items should be properly stored in refrigerators.
 8. Instruct teams to prepare $\frac{1}{4}$ cup each of three slightly different trail mix variations for their initial team taste tests. Students should follow the taste test instructions provided on pages 16 and 17. The trail mix recipe that receives the highest score in the team taste test will be used to develop the team's final trail mix recipe.
 9. After establishing their final trail mix recipe, each team should complete all steps of production listed in the job descriptions for the product development team. Each team should produce one cup of their packaged trail mix product.
 10. As a culmination, product development teams will present their product to the class by using a skit, video, radio broadcast, or other multimedia method.
 11. Hold a taste-test party for students to sample trail mix recipes developed by other teams.

Variation

- ▶ Allow students to create other products besides trail mix. Examples include dips, cookies, spreads, jams, etc.
- ▶ Instruct students to conduct their taste test with a larger sample of people from their selected target group.
- ▶ If a school kitchen is available, ice cream flavor product development offers many exciting possibilities.

Mix It Up!

Food Scientist

Extension

- ▶ Include a requirement for teams to devise a QR code that links to a Web page ad for their product.
- ▶ Have students research colleges that offer food science programs and summarize the different pathways of study and job opportunities. Discovery Education provides a helpful page: school.discoveryeducation.com/foodscience/college_resources.html#curriculum

ELL Adaptation

- ▶ Place ELL students in groups with students who are proficient in English.
- ▶ Instruct teams to create Spanish, or other language versions of labels and advertisements.

Product Development Team Grading Rubric

Team Members

Product Name

Category	4	3	2	1
Requirements	All requirements for each task are met and exceeded.	All requirements for each task are met.	One requirement from a task was not completely met.	More than one requirement from one or more tasks was not completely met.
Workload	The workload is equally shared and communicated by all team members.	The workload is equally shared but team members did not communicate on a consistent theme.	The workload was divided, but one person in the group did not do his/her fair share.	Several people in the group did not do their fair share.
Presentation	Well designed with content that holds the audience's attention the whole time.	Well designed with content that holds the audience's attention most of the time.	Content of presentation is complete but not delivered in a method that holds the audience's attention.	Design lacks a cohesive message and audience is not sure of presentation message.

Circle the score for each category and add up the total. Total points possible = 12.

Score earned: _____

Market Analysis Checklist

- ☐ Who is the target audience for your product? _____
For example, will you be marketing to young children, teens, parents, senior citizens?
- ☐ Research to determine the qualities your target audience prefers in a trail mix. This can be done through a survey. Surveys may be conducted through social media, paper and pencil, or other appropriate methods. For example, ask your audience to list their top three ingredient choices for trail mix.
- ☐ Number of people surveyed. _____ Method of survey used. _____
Three most popular trail mix ingredients based on survey results. _____

- ☐ Determine a name for the new product.
- ☐ Determine a slogan for the new product.
- ☐ Design an advertising campaign that is adapted to the target audience.
 - ▶ Your team will present your final trail mix product and advertising campaign to the class at the end of the project.

Graphic Design Checklist

- ☐ Create a label for the product that includes:
 1. Product name
 2. Product slogan and logo
 3. Ingredients and storage requirements
 4. Nutritional information (*model format after traditional food labels*)
 5. Recommended serving size
 6. Attractive graphics that are appropriate for the target audience
- ☐ Find an appropriate container for the product and attach the label.
- ☐ Design artwork for product advertising campaign.

Food Chemistry Checklist

- ☐ Prepare three, slightly different trail mix recipes based upon preferred ingredients from your survey results. Prepare approximately $\frac{1}{4}$ cup of each of these recipe variations. Your trail mix's taste, texture, smell, and appearance will all play a role in how well your product is rated.
- ☐ Conduct a taste test among your team members to determine which of your three trail mix recipes is the best. Use the taste test guidelines and score sheet on pages 16 and 17.
- ☐ Once your team has determined the best trail mix recipe from the taste test, you will fine tune that recipe to develop one cup of your final trail mix product. Carefully record:
 1. Ingredients
 2. Measurements
 3. Procedure
- ☐ Conduct multiple trials to ensure the recipe can be replicated.
- ☐ Determine the shelf life and storage requirements after opening the product.
- ☐ Provide all the information that is needed to graphically design the product label.
- ☐ Research the regulatory compliance necessary to sell your product to the public.

Cost Analysis Checklist

- ☐ Use a spreadsheet to determine the cost of the following product components:
 1. Ingredients (*research bulk food prices online or by visiting local grocery stores*)
 2. Packaging
- ☐ Determine pricing for your trail mix.

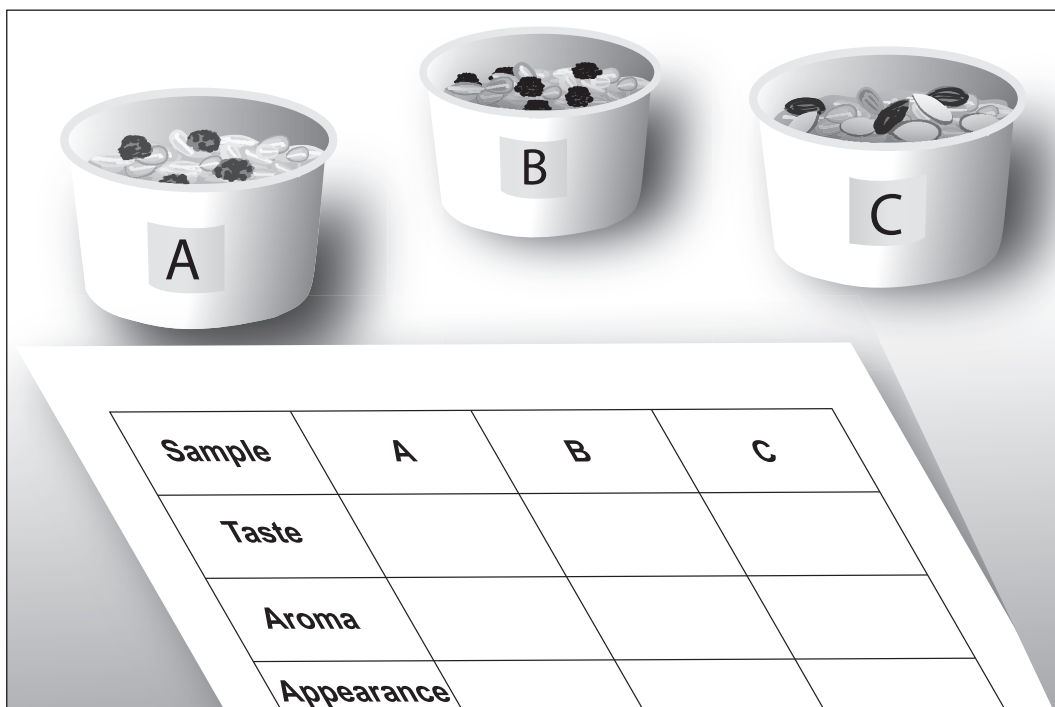
Example Spreadsheet

Ingredients list	Ounces of each ingredient per one cup of trail mix	Cost per ounce (Note: 1 lb = 16 oz)	Cost of each ingredient per one cup of trail mix
<i>Almonds</i>	<i>4 oz</i>	<i>\$0.43</i>	<i>\$1.72</i>
Total Cost of Ingredients:			

- ☐ What is the total cost of all ingredients in the cup of trail mix you created? _____
- ☐ How much does one cup of your trail mix weigh? This number should be listed on your package. _____
- ☐ How much does the package for your product cost? _____
- ☐ Factor in the appropriate percent markup of your cost in order to make a profit. What price will you set for one cup of your trail mix? _____
- ☐ List three possible methods for shipping your product to one specific store and the pros and cons of each shipping method. _____

Taste Test Guidelines

1. Provide each member of your team with approximately one-tablespoon of each of the three recipe variations of your trail mix. Samples can be placed in small paper cups that are labeled A, B, and C.
2. Provide a score sheet, napkin, cup of water, and spoon for each member.
3. Team members should not talk to one another during the taste test and should not be able to see how other team members are scoring each sample.
4. Ask each team member to test sample “A” by first recording their score for appearance, then aroma, then taste, and finally texture. Note that texture pertains to how the food feels in your mouth. *For example: crunchy, chewy, juicy, soggy, creamy, and so on.*
5. After testing the sample, have team members take a drink of water to cleanse their palette.
6. Repeat steps four and five for samples “B” and “C.”



Taste Test Score Sheet

	Recipe A	Recipe B	Recipe C
Appearance (1-5)			
Aroma (1-5)			
Taste (1-5)			
Texture (1-5)			
Total Score			

Scoring Value

- 1 = Not fit for consumption
- 2 = Poor
- 3 = Neutral
- 4 = Good
- 5 = Excellent



Taste Test Score Sheet

	Recipe A	Recipe B	Recipe C
Appearance (1-5)			
Aroma (1-5)			
Taste (1-5)			
Texture (1-5)			
Total Score			

Scoring Value

- 1 = Not fit for consumption
- 2 = Poor
- 3 = Neutral
- 4 = Good
- 5 = Excellent

Cruisin' for a Bruisin'

Food Packaging Specialist

Purpose

In this lesson students will learn that product packaging is a balance between function, food safety, and economics by designing a protective package for shipping perishable fruit. Each package will be presented to the class for evaluation, and the best design will be shipped to test the product's durability.

Time

Teacher Preparation:
30 minutes

Student Activities:
Six 50-minute sessions

Materials

For the teacher:

- ▶ Packaging rubric
- ▶ Examples of fruit packaging materials
- ▶ Packaging materials for students
- ▶ Samples of one type of fruit for students to measure and weigh

For each group:

- ▶ Packaging materials for fruit package design
- ▶ Internet access
- ▶ Scale

Background Information

Many considerations go into packaging a food product. The process involves science, technology, engineering, and math and requires a balance between function, food safety, and economics. Many universities have degree programs in food science and technology. Students studying food packaging develop skills in designing innovative packaging styles with exciting opportunities to work on “greener” packaging using biodegradable or recyclable materials.

When designing new food packaging, specialists must consider the mode of transportation, distance, methods for preventing spoilage, food safety regulations, consumer appeal, package durability, cost of packing materials, and much more. In depth information on food packaging materials, reducing waste and environmental impact may be found by searching these topics on the Institute of Food Technologists website www.ift.org.

Packaging is the third largest industry in the United States. Approximately ten percent of each dollar we spend on a product is related to the cost of packaging. Many job opportunities exist in packaging and potential job titles include packaging engineer, packaging scientist, packaging sales and structural designer. The Institute of Food Technologists has a list of universities with food science and technology departments at www.ift.org/community/students/approved-undergrad-programs.aspx

Procedure

Day 1

1. This lesson focuses on the science of food packaging and uses fruit as a specific example. Provide several examples of fruit packaging containers for students to examine. Examples include strawberry clam shells, cardboard trays with indentations for holding individual pears or apples, and sacks of oranges. If examples are not available, show the class online examples. Ask students why they think fruit packaging is important. Make a list of ideas on the board.
2. Use the background information to help develop the list on the board of who is involved in food packaging, its importance, and

Cruisin' for a Bruisin'

Food Packaging Specialist

For each student:

- ▶ Packaging rubric (page 24)
- ▶ *Cruisin' for a Bruisin'* lab worksheet (pages 25-29)
- ▶ Packaging materials

California Standards

Standards alignment is listed in the matrix on page 61.

Grade 6

Common Core English Language Arts

RL.6.3
SL.6.1, 6.2, 6.5
WHST.6.6, 6.7, 6.8

Common Core Mathematics 6.EE.2c

Next Generation Science Standards

MS-ETS1.A
MS-ETS1.B
MS-ETS1.C
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
ESS3.C

Visual and Performing Arts Content Standards

Aesthetic Valuing 4.3

possible careers. Effective food packaging is important to farmers because they want their product to look appealing and taste fresh when it gets to consumers. Farmers, however, also need to consider the cost of the packaging. Expensive packaging can reduce profits that farmers need to make from the sale of their products. Product packaging is important to consumers who want to purchase a piece of fruit that smells good, tastes good, is clean, is not bruised or damaged, and has been packaged using safe food handling practices and materials.

3. Explain that students will take on the role of food packaging specialists in a challenge to design the best package to ship one piece of fruit. Not only should the package protect the fruit, but it should also be cost efficient and environmentally friendly. For example, a group could place a piece of fruit inside a very large box that is packed with layers and layers of bubble wrap. While this box might prevent the fruit from being damaged, its large size and use of extra materials would be costly to assemble and ship, and would generate a lot of waste.
4. Distribute the *Cruisin' for a Bruisin'* lab worksheet and packaging rubric. Explain the lesson process and evaluation using the rubric.
5. Organize students into groups. Explain that each individual in the group will design and test their own package prototype. The best package in the group will be selected based on rubric scores on package design and durability. The group will then have the opportunity to work together to fine tune the best designed package from their group, which will be presented to the class. The class will then vote on one package to be shipped in the mail with a piece of fruit.

Day 2

1. Instruct groups to begin their design process by researching materials and designs for their fruit package. Packages should be designed to hold one piece of fruit, such as an apple, pear, or orange. As a class decide which type of fruit the packages will be designed for. This will keep package material cost and shipping cost uniform.
 - ▶ The packaging should be suitable for shipping the piece of fruit through the U.S. Postal Service.

Cruisin' for a Bruisin'

Food Packaging Specialist

California Standards (cont.)

Grade 7

Common Core English Language Arts

RL.7.3

SL.7.1, 7.2, 7.5

WHST.7.6, 7.7, 7.8

Next Generation Science Standards

MS-ETS1.A

MS-ETS1.B

MS-ETS1.C

MS-ETS1-1

MS-ETS1-2

MS-ETS1-3

MS-ETS1-4

ESS3.C

Visual and Performing Arts Content Standards

Aesthetic Valuing 4.4

Grade 8

Common Core English Language Arts

RL.8.3

SL.8.1, 8.2, 8.5

WHST.8.6, 8.7, 8.8

Common Core Mathematics 8.G.9

- ▶ Examples of websites with packaging materials:

Monte Packaging Company www.montepkg.com

Hescow www.hesco-fl.com

Expedx www.xpedx.com/packaging-solutions

- ▶ Explain to the students that they are not to purchase items from the websites, but they should use the websites to gather ideas for types of materials that could be used to package fruit.

2. After researching materials, students should assess the feasibility of several materials and designs that might work for their fruit packages. Each student should sketch their own design ideas on their lab sheet along with a list of materials and dimensions.
3. Each group should brainstorm ideas for their company name and design a decorative label that will go on the fruit. This should be recorded on the lab sheet.
4. As homework, each student will gather their necessary packaging materials. Suggest that students look in their recycling bins at home or at school. You may supply some basic materials, such as tape or cardboard if needed. Examples of packing materials include cardboard, wood shavings, corn packing peanuts, newspaper, tissue paper, cellophane, poster board, foam board, lint, and wool.

Day 3

1. Students will meet in their groups and each student will design and build their own prototype package. Students may use the sample pieces of fruit to establish necessary dimensions for package design, however, package evaluation and testing will be done without fruit inside the package.

Day 4

1. Each student will present their prototype package to the group and the group will evaluate the prototype for craftsmanship, aesthetics, and use of materials using the packaging rubric.
2. Each student will then subject their package prototype to a durability test for tearing and crushing. Following the test, students will report back to their groups to use the rubric to rate the durability of their packaging.

Cruisin' for a Bruisin'

Food Packaging Specialist

California Standards (cont.)

Grade 8 (cont.)

Next Generation Science Standards

MS-ETS1.A
MS-ETS1.B
MS-ETS1.C
MS-ETS1-1
MS-ETS1-2
MS-ETS1-3
MS-ETS1-4
ESS3.C

Visual and Performing Arts Content Standards

Aesthetic Valuing 4.4

3. The package design with the highest score from the rubric will be chosen for further development.

Day 5

1. The group will develop one final package for their fruit based on improving the design of the package that received the highest score from the rubric. The group must keep track of materials cost, package dimensions, shipping cost, and logistics.

Day 6

1. Groups will present their package design, cost of materials, and cost of shipping to the class.
2. Ask students to think like a farmer who has grown the fruit. This farmer wants to choose a design that is durable enough to deliver their fruit to customers without any damage. The farmer also wants to choose a cost effective package.
3. Instruct the class to vote on the best package for shipping a piece of fruit.
4. The chosen package should be dropped off at the post office and shipped to the class address. When the package arrives at school, the class will evaluate the condition of the package and the fruit and will come up with ideas for package improvements.

Variations

- ▶ Have each group mail their own package of fruit.
- ▶ Have groups compare rates of different shipping companies.

Extensions

- ▶ Tour a fruit packaging operation or take a virtual tour of a fruit packaging operation with YouTube.
- ▶ Show students the Red Blossom California Strawberries website www.rbtrace.com and watch the strawberry packing video clip. Go through the trace back example to see how customers can enter the code on the bottom of their Red Blossom clamshell container to see what farm grew their strawberries, the variety, and date the strawberries were picked.

Cruisin' for a Bruisin'

Food Packaging Specialist

ELL Adaptations

- ▶ This lesson incorporates hands-on activities. Kinesthetic learning events provide an excellent learning environment for English language learners.
- ▶ Demonstrate all lab procedures to the class before beginning the lab.
- ▶ Add new vocabulary to a word wall and match photos to the new words.

Packaging Grading Rubric

Student's Name _____

Category	4	3	2	1
Design of Exterior Packaging	The packaging shows that the creator took great pride in his/her work. The design and construction look carefully planned. The item is neat.	The packaging shows that the creator took pride in his/her work. The design and construction look planned. The item has a few flaws but these do not detract from the overall look.	The packaging design and construction were planned. The item has several flaws that detract from the overall look.	The packaging looks thrown together at the last minute. It appears that little design or planning was done. Craftsmanship is poor.
Wise use of Materials	Thinking and planning is evident in choice of materials. Lightweight materials were selected for shipping efficiency. All packaging materials are recyclable and produce minimum waste.	A combination of lightweight packaging materials were used and at least 50% are recyclable.	A combination of light and heavyweight packaging materials were used, but less than 50 % are recyclable.	The packaging material is heavy and excessive. Materials produce a lot of waste and are not recyclable.
Durability	The package is sturdily built and resists crushing and movement in durability test.	Most of the package is sturdy, but there was one weak spot that caved in or tore with pressure and movement.	Some of the package is sturdy but more than one weak area caved in or tore with pressure and movement.	The package is flimsy and fell apart easily. Damage to package contents is inevitable.

Total Score = _____ out of 12 points possible.

Cruisin' for a Bruisin' Lab

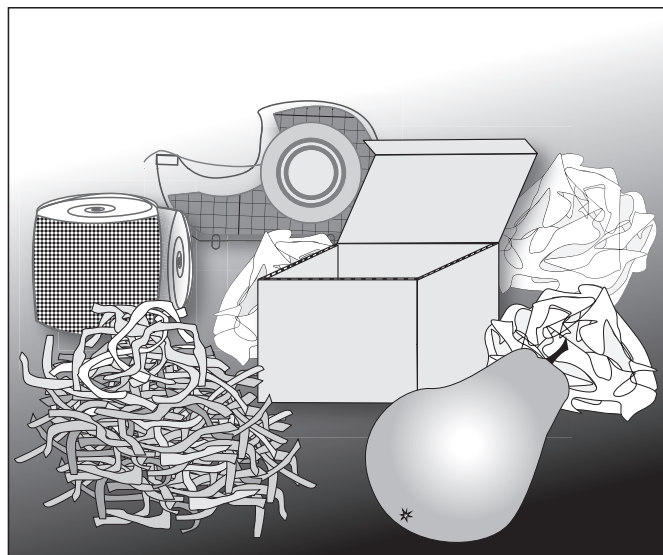
Name: _____

Research

Use the Internet to research materials for packaging for one piece of designated fruit. Examples of websites with packaging materials:

- ▶ Monte Packaging Company *www.montepkg.com*
- ▶ Hesco *www.hesco-fl.com*
- ▶ Expedx *www.xpedx.com/packaging-solutions*

List materials, cost, and descriptions in the table below. You will not purchase any of these materials. Instead, use the ideas from the websites to find similar packaging materials from your home or school recycling bins.



Materials	Cost	Description and Recycle Options

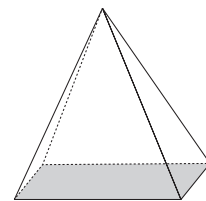
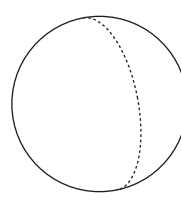
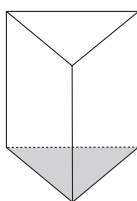
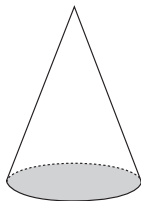
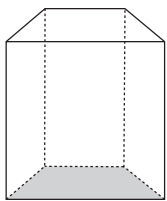
Cruisin' for a Bruisin' Lab (continued)

Label

This label is designed to be placed on each piece of fruit with the company's name and logo. It should be appealing to customers. Sketch your label idea below and share with your group members. Your group will choose one label design for your final fruit package.

Package Construction

1. Determine the size and shape of the package needed to contain your fruit.



Measure the width, or diameter, and height of your piece of fruit and include units.

Diameter = _____ $\frac{1}{2}$ diameter = _____ radius

Height = _____

What is the volume of your piece of fruit? *Volume of a sphere* = $(\frac{4}{3})\pi r^3$

Volume = _____

Based on this information, the package needs to be at least _____ tall and _____ wide and hold a volume of _____ (Leave some extra space for padding materials.)

You may wish to wrap your fruit. Calculate the surface area of your fruit to determine the amount of wrapping you will need. *Surface area of a sphere* = $4\pi r^2$

Surface area of fruit = _____

Cruisin' for a Bruisin' Lab *(continued)*

2. After researching packaging materials and determining package size, brainstorm designs and materials that might work for packaging the piece of fruit.

- ▶ Sketch your design idea and label the dimensions. Make a list of materials.

Sketch	Materials

- ▶ For homework, gather the necessary packaging materials. Look in your recycling bins at home or at school for materials that can be repurposed. Materials should be clean so they do not contaminate the fruit.
3. Bring your packaging materials to class and work in your group. Each group member will construct their own fruit package prototype.
 4. Present your package prototype to your group members.
 - ▶ As a group, you will evaluate each group member's package prototype for design and wise use of materials. Use the packaging rubric to score each package.
 - ▶ Next, test the durability of your package prototype by adding masses of varying sizes to the top of the package. For example, you could place one or several books on top of the package. Note any sagging, ripping, or breaking.

Cruisin' for a Bruisin' Lab *(continued)*

Durability Test

Mass placed on package	Observations

- ▶ Following the durability test, report back to your group and use the rubric to rate the durability of your packaging.
- ▶ The package design with the highest score from the rubric will be chosen to represent your group in the class competition for the best package design.
- ▶ As a group, make any final upgrades to the winning package prototype and fill in the chart below with details about your selected packaging. Look up the cost of materials on the Web.

Selected Group Package

Sketch
Materials
Cost of Materials
Dimensions

Cruisin' for a Bruisin' Lab *(continued)*

Shipping

Shipping cost to ship package from the nearest post office to our class.

Package weight (with fruit) = _____

Package size = _____ wide _____ long and _____ deep.

Use the U.S. Postal Service website at *postcalc.usps.com* and the required ZIP codes, date, and weight. Select the "Package" option (do not select the flat rate service). On the pricing page, select the "Other Options" bar to find the shipping cost for "Standard Post."

Shipping cost = \$_____

Total cost of package materials \$_____ + shipping \$_____ = \$_____

5. As a group, present your package design to the class.
 - ▶ Describe the materials used for construction, what they cost, whether or not they can be recycled, and how the package rated in the durability test.
 - ▶ The class will vote on the winning package design based upon which package is the most likely to deliver a visually appealing fruit product safely through the U.S. Postal Service in a cost effective manner.
 - ▶ The chosen package will be packed with a piece of fruit and shipped from the post office to the class address.
6. As a class, inspect the package and its fruit contents when it is delivered by mail to your classroom.
 - ▶ Describe the condition of the packaging.
 - ▶ Describe the condition of the fruit.
 - ▶ How could you improve the packaging?

Food on the Move

Food Transportation Specialist

Purpose

In this lesson, students will learn about the top agricultural commodities of different regions of California and the logistics involved in transporting those commodities to consumers.

Time

Teacher preparation:

30 minutes

Student activities:

Approximately five 50-minute sessions

Materials

For the teacher:

- ▶ *California Agriculture Quiz answers*
www.LearnAboutAg.org/agquiz

- ▶ *Food Transportation slide show*
www.LearnAboutAg.org/stem

For each group:

- ▶ Computer and Internet access

For each student:

- ▶ One 4x6 inch index card
- ▶ *California Grows*
www.LearnAboutAg.org/cagrows
- ▶ *Trucking Logistics* worksheet (page 37-39)
- ▶ *California Agriculture Quiz*
www.LearnAboutAg.org/agquiz

Background Information

This lesson focuses on the role of transportation specialists in the shipping and tracking of California's agricultural products. Agriculture is one of California's leading industries and California ranks as the number one agricultural state in the nation. More than 400 different crops and livestock commodities are produced in California and these commodities are shipped all over the world.

Agricultural transportation specialists work on designing efficient transportation systems for perishable food and nursery products throughout the states and worldwide. This includes many challenges such as planning for inspection for invasive species in products at quarantine checks, weight limits on truck loads of product, and establishing efficient routes. The goal is to design a system that makes customers happy, is safe and rewarding for employees, and profitable for businesses.

Transportation design is a rewarding field for the type of person who is always thinking of a better way to deliver products to customers. This lesson will allow students to use their problem solving skills to design the best transportation system to ship a commodity from where it is produced in California to customers in a different region of the state.

Procedure

Find out what students already know about agriculture by completing the *California Agriculture Quiz* together as a class. Read a question to the class then have students turn to a neighbor for discussion. Ask partners to raise their hands to give their answers. After you are finished, review the correct answers with the class.

Part 1

Getting to Know Our Commodities

Explain to students that they will be learning more about the different agricultural products produced in different regions of California as they take on the role of a transportation specialist in charge of designing trucking routes for pick up and delivery of agricultural products.

1. Assign a California county to each student.

Food on the Move

Food Transportation Specialist

California Standards

Standards alignment is listed in the matrix on page 61.

Grade 6

Common Core English Language Arts

RST.6.3
SL.6.1, 6.5
WHST.6.6

Common Core Mathematics

6.EE.2a
6.EE.2c

Next Generation Science Standards

MS-ETS1.A
MS-ETS1.B
MS-ETS1-1
MS-ETS1-2

Grade 7

Common Core English Language Arts

RST.7.3
SL.7.1, 7.5
WHST.7.6

Common Core Mathematics

7.RP.3
7.EE.4a

Next Generation Science Standards

MS-ETS1.A
MS-ETS1.B
MS-ETS1-1
MS-ETS1-2

2. As a class, review the *California Grows* map and point out the location of each student's assigned county. Discuss vocabulary that students may be unfamiliar with, such as commodity, crop, horticulture, specialty crop, forest product, stockers and feeders, processing tomatoes, woody ornamentals, cattle and calves, timber, bedding plants, alfalfa, poultry, nursery products, pasture, range, foliage plants, and cut flowers. Definitions may be found in the glossary on page 73.
3. Explain to students that they will be using the *California Grows* map to identify the three top commodities from their assigned county. Instruct students to choose one of these top commodities to research. A commodity is a primary agricultural product that can be bought and sold such as apples, wheat, or milk.
4. Distribute an index card to each student and demonstrate how they should use their *California Grows* map to sketch an outline of the shape of their assigned county on their index card. Students will then write commodity facts inside the shape of their county that has been sketched on their index card. If possible, have students type the information regarding their commodity on the computer in a small font. This can then be printed, cut out, and pasted on their index card. After the commodity facts have been written or pasted on the index card, students can then cut it out in the shape of their assigned county.
5. As a class or for homework, have students research the following facts about one of the top commodities from their assigned county. Helpful resources include Agricultural Fact and Activity Sheets from California Foundation for Agriculture in the Classroom, www.LearnAboutAg.org/factsheets; County Agricultural Commissioners' Reports from USDA's National Agricultural Statistics Service, www.nass.usda.gov/ca; or online searches for "California + the commodity name."
 - ▶ Name of commodity
 - ▶ Picture of commodity
 - ▶ How it is grown/raised
 - ▶ Uses
6. Once students have completed their commodity fact cards, instruct them to take their cards to the board and tape them in the correct geographical area of California. The end result should be a map of California showing one of the top commodities in each county. It may be helpful to sketch a large outline of California on the board

Food on the Move

Food Transportation Specialist

California Standards (cont.)

Grade 8

Common Core English Language Arts

RST.8.3

SL.8.1, 8.5

WHST.8.6

Next Generation Science Standards

MS-ETS1.A

MS-ETS1.B

MS-ETS1-1

MS-ETS1-2

ESS3.C

or on a piece of butcher paper for students to attach their county index cards.

7. Facilitate a class discussion on the commodities by asking each student to contribute a few key facts about the commodity they researched. Discuss the different regions of California and ask students if they have any idea why certain commodities are produced in one area of the state and not another. For example, why is timber a top crop in Trinity County but not in San Joaquin? Discuss topography, climate, and population factors that make certain areas best suited for producing a particular commodity.

Part 2

Transporting Our Commodities

Pick a couple of examples from the California commodity map that your class has created. Ask students if they think the commodity is consumed only by the people living in that county. Who else might need or want this commodity? Where would it need to be shipped? How would it get there? Tell students that they will address these questions as they take on the role of food transportation specialists in the next part of the lesson.

1. Present the *Food Transportation* PowerPoint to the class. This may be found at www.LearnAboutAg.org/stem.
2. Organize the class into small groups and assign a *Commodity Transportation Scenario* to each group (scenarios may be used more than once).
3. Explain that students will use a semi truck to pick up and deliver their commodity to the assigned location. Show students how to use their *Trucking Logistics* worksheet to calculate the distance of each leg of the trip, amount of diesel used, and cost of the fuel. Ask students if they think it is okay for trucks to drive on any road, and why or why not. Some trucks may be too tall for tunnels or overpasses, too heavy for bridges, or too long to make tight turns on twisty roads. More information on California trucking routes may be found at www.dot.ca.gov/hq/traffops/trucks/truckmap. Also note that truck drivers need to take meal and rest breaks. Just because a map says it will take 12 hours from one stop to the next does not mean that the driver will make the trip in 12 hours.

Food on the Move

Food Transportation Specialist

4. When finished with the *Trucking Logistics* worksheet, instruct each group to design a brief infomercial that they will present to the class to explain their plans for shipping their commodity from point A to B. The infomercial should include:
 - a. A description of the commodities being shipped, and the region where they were produced.
 - b. The type of truck needed for transport and any special considerations such as refrigeration.
 - c. Description of transport route.
 - d. Description of any food safety measures that need to be addressed while transporting the commodity.

Variations

- ▶ Modify the commodity transportation scenario using your home county rather than the whole state.
- ▶ If time is limited, doing only the first part of the lesson will still provide students with knowledge about the agricultural commodities grown in California.

Extensions

- ▶ Have students present their commodity index card to the class.
- ▶ Prior to doing this lesson, take a class period to do a geography lesson on each California county. Discuss different regions of the state, differences in climate, topography, and whether the majority of the land is urban, agricultural, forested, or undefined.
- ▶ Assign students two counties for Part One, in order to have every California county represented on the class map.
- ▶ For the transportation scenario, have students look up any quarantine restrictions that may be associated with the commodity they are transporting. Check the California Department of Food and Agriculture Department (CDFA) website www.cdffa.ca.gov and search for “quarantine information and maps.”

Food on the Move

Food Transportation Specialist

- ▶ For the transportation scenario, have students calculate break times into the total amount of time a driver takes to pick up and deliver their load. For example, a map might show that it takes 15 hours for a driving route, but a truck driver will take more than 15 hours to complete the route due to rest breaks.
- ▶ This lesson provides a simplified version of how commodities are shipped throughout the state. Invite a transportation specialist to speak to the class about modern efficiencies in trucking and route design.

Commodity Transportation Scenarios

For each of the following scenarios, begin your trip from your truck fleet home base (your school) and then map a route using the Google Map at www.google.com/maps/5oCzG to collect the listed goods. You may collect the goods in whichever order you think makes the most sense. After delivery, you will return to the truck fleet home base (your school).

Home Improvement

Collect lumber from the sawmill in Trinity County and ornamental plants from the nursery in Orange County. Deliver these goods to a hardware or building store in (your city).

Snack Attack

Collect raisins from Fresno County and apples from the apple orchard in El Dorado County. Bring the snacks to the hungry kids at the Del Mar Soccer Club in San Diego.



Milk Run

Get milk from the Glenn County dairy and Kern County dairy. Deliver to the Santa Barbara Foodie Mart.

Fish Market

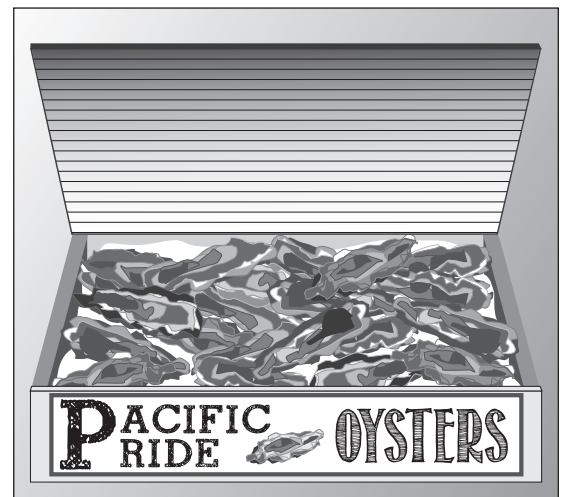
Collect oysters from the oyster farm in Humboldt County and trout from the Fresh Fish Company in Sacramento. Travel to Pier 39 in San Francisco to sell the commodities.

Hungry Horses

Collect corn grain from the farm supply store in Contra Costa County and alfalfa hay from Imperial County. Deliver your load to Golden Gate Fields in Berkeley.

Bee Swarm

Put on your beekeeper suit. You will go to the apiary in Inyo County and the Honey Bee Farm in Tehama County to collect beehives. Take the bees to the almond orchard in Colusa to pollinate the almond trees.



Trucking Logistics

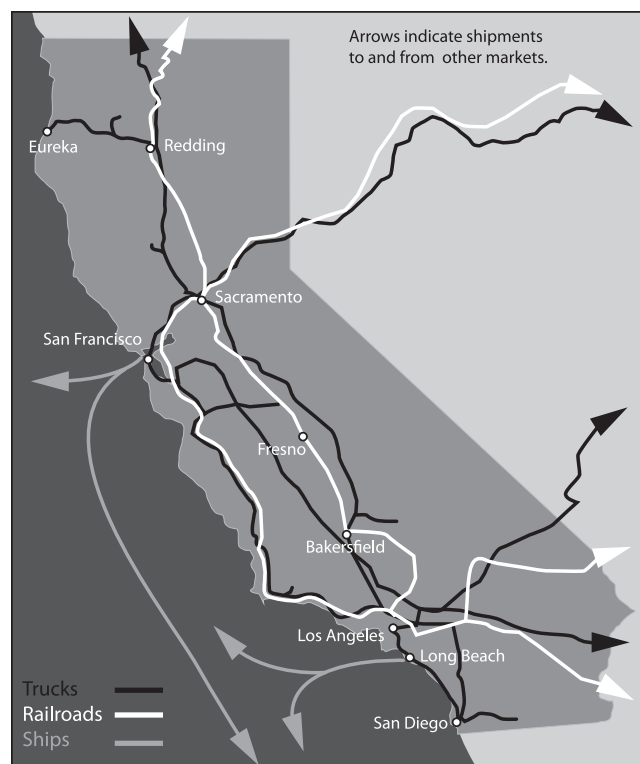
Name: _____

Use this spreadsheet and the prepared Google Map www.google.com/maps/5oCzG to determine the truck route, mileage, time, and cost of transporting your commodities. Each member of your group should be responsible for calculating one leg of the journey.

Example:

Starting Location	Sacramento
Stop 1 Location	Folsom
Distance from Start to Stop 1	30 miles
Time	33 minutes
Fuel used (assume truck gets 6.5 mpg)	4.6 gallons (30 miles / 6.5 mpg)
Cost of fuel (using current rate for diesel fuel)	\$19.32 (4.6 gallons x \$4.20 per gallon of diesel)
Description of Route	Highway 50

*The map below represents an example of some shipping routes.
You are not limited to these routes for shipping your commodities.*



List the commodities you are transporting:

List the current rate for diesel fuel:

\$ _____ per gallon.

Trucking Logistics *(continued)*

Leg 1 of Journey

Starting Location <i>(home base = your school)</i>	
Stop 1 Location	
Distance from Start to Stop 1	
Time	
Fuel used <i>(assume truck gets 6.5 mpg)</i>	
Cost of fuel for Leg 1	
Description of Route	

Leg 2 of Journey

Starting Location <i>(stop 1)</i>	
Stop 2 Location	
Distance from Stop 1 to Stop 2	
Time	
Fuel used <i>(assume truck gets 6.5 mpg)</i>	
Cost of fuel for Leg 2	
Description of Route	

Leg 3 of Journey

Starting Location <i>(stop 2)</i>	
Stop 3 Location	
Distance from Stop 2 to Stop 3	
Time	
Fuel used <i>(assume truck gets 6.5 mpg)</i>	
Cost of fuel for Leg 3	
Description of Route	

Trucking Logistics *(continued)*

Leg 4 of Journey

Starting Location <i>(stop 3)</i>	
Stop 4 Location <i>(truck fleet home base = your school)</i>	
Distance from Stop 3 to Stop 4	
Time	
Fuel used <i>(assume truck gets 6.5 mpg)</i>	
Cost of fuel for Leg 4	
Description of Route	

Journey Totals

	Leg 1	Leg 2	Leg 3	Leg 4	Total
Gallons of Fuel					
Cost of fuel					
Distance					
Time					

As a transportation specialist, you need to consider all of the factors that impact the cost of transporting commodities. Fuel is only one part of the equation. You also need to pay the driver of the truck.

1. Write an equation that describes the cost of transporting your assigned commodities and paying your truck driver.
2. List some ideas for improving efficiency of transporting agricultural products to customers.

Food Safety Sleuths

Food Safety Specialist

Purpose

In this lesson students will learn about foodborne illness, its prevention, and the people and organizations that are involved in food safety. Students will conduct an experiment to learn how hand-washing affects the presence of bacteria on their hands.

Time

Teacher Preparation:
30 minutes

Student Activities:
Two class sessions, plus 10 minutes per day over the course of one week for data collection

Materials

For the teacher:

- ▶ *Perils at the Picnic* at www.fightbac.org or www.LearnAboutAg.org/stem
- ▶ *Food Safety Sleuths* PowerPoint www.LearnAboutAg.org/stem

For each group:

- ▶ Four sterile nutrient agar plates
- ▶ Clear tape
- ▶ Resealable plastic bag
- ▶ Permanent marker
- ▶ Heat lamp or incubator

Background Information

A foodborne illness is when a person becomes sick after consuming food that is contaminated with:

- ▶ microorganisms such as bacteria, viruses, and parasites
- ▶ chemicals such as household cleaners
- ▶ physical objects such as glass or metal

Symptoms of foodborne illness include upset stomach, nausea, vomiting, stomach cramps, fever, and diarrhea.

Microorganisms play a role in the majority of foodborne illnesses. Most microorganisms are harmless, yet some can make us sick. The microorganisms that cause illness are called pathogens.

- **Viruses** are the smallest forms of life on Earth, yet cannot reproduce outside of a living host cell. Viruses are responsible for illnesses like colds and flu. Hepatitis A and norovirus are examples of viruses that cause foodborne illnesses.
- **Parasites** are tiny organisms that require a host to live. Examples are amoebas that may be found in unclean drinking water, Anisakis roundworm that can be found in fish, and *Trichinella spiralis* that may be found in pork.
- **Fungus** including yeasts and molds are often used in making foods such as bread and cheese, but can also spoil food and make people sick.
- **Bacteria** are single-celled organisms. While most are harmless, some are pathogenic. These pathogenic bacteria are often responsible for most cases of foodborne illness. Using nutrients found in food, bacteria can quickly multiply under the right temperature conditions. As bacteria multiply, they excrete toxic waste products that can make people sick after consuming contaminated food. If conditions are favorable, bacteria numbers can double every ten to thirty minutes.

Proper food handling, storage, and preparation can prevent most foodborne illnesses caused by the pathogens described above. There are many careers dedicated to keeping our food safe. These careers involve the latest in science and technology to find new methods of providing people with a healthy food supply. The U.S. Department of Food and Agriculture (USDA) regulates meat, poultry, and eggs,

Food Safety Sleuths

Food Safety Specialist

(optional)

- ▶ Soap, water, and paper towels
- ▶ Hand sanitizer
- ▶ *Presentation rubric* (page 51)

For each student:

- ▶ *Hands On!* lab worksheet (page 46)
- ▶ *Perils at the Picnic* found at www.fightbac.org or www.LearnAboutAg.org/stem
- ▶ *Food Safety Sleuths* handout (page 50)

California Standards

Standards alignment is listed in the matrix on page 61.

Grade 6

Common Core English Language Arts

RST.6.3
SL.6.1, 6.2, 6.5
W.6.1
W.6.2
WHST.6.6
WHST.6.7
WHST.6.8

Next Generation Science Standards

MS-LS2.A
MS-ETS1.A
MS-ETS1.B
MS-ETS1-3

and the U.S. Food and Drug Administration regulates the rest of the food produced in or imported into the country. Local health inspectors regulate restaurants, supermarkets, and other food service businesses and organizations in our communities.

In general, a food safety specialist's job is to make sure that our food is wholesome and safe by applying their knowledge of food science, bacteriology, microbiology, food laws, regulations, and hazard analysis. Food safety specialists work in hotels, government agencies, restaurants, factories, and more. There are a wide range of employment opportunities and careers linked to food safety. Visit the USDA Food Safety and Inspection Services website www.fsis.usda.gov and select *Careers* then *Opportunities* and *Types of Jobs* to read descriptions of duties and qualifications.

Everyone can play a role in preventing foodborne illness. Food safety specialists recommend following *four simple steps* before handling or eating food: clean, separate, cook, and chill.

Clean

- Wash hands with soap and water for 20 seconds or for the length of time it takes you to sing the happy birthday song twice.
- Wash utensils, cookware, and surfaces with soap and water.
- Rinse fruits and vegetables with water. (Do not wash meat or eggs.)
- Cover your mouth and nose with your elbow when coughing or sneezing. Wash your hands after blowing your nose.

Separate

- Use separate cutting boards and plates for raw produce, meat, poultry, seafood, and eggs.

Cook

- Bacteria that cause food poisoning multiply quickest between 40 degrees Fahrenheit and 140 degrees Fahrenheit—this temperature range is known as the *Danger Zone*. Cooked food is safe after it has been heated to at least 140°F. Use a food thermometer to check the temperature of cooked food. Microwave foods to 165°F.

Food Safety Sleuths

Food Safety Specialist

California Standards (cont.)

Grade 7

Common Core English Language Arts

RST.7.3
SL.7.1, 7.2, 7.5
W.7.1
W.7.2
WHST.7.6
WHST.7.7
WHST.7.8

Next Generation Science Standards

MS-LS2.A
MS-ETS1.A
MS-ETS1.B
MS-ETS1-3

Grade 8

Common Core English Language Arts

RST.8.3
SL.8.1, 8.2, 8.5
W.8.1
W.8.2
WHST.8.6
WHST.8.7
WHST.8.8

Next Generation Science Standards

MS-LS2.A
MS-ETS1.A
MS-ETS1.B
MS-ETS1-3

Chill

- Refrigerate perishable foods within two hours to slow the growth of illness-causing bacteria. Refrigerators should be kept between 40°F and 32°F, and your freezer should be 0°F or colder.
- Don't thaw or marinate foods on your kitchen counter or table. Instead, thaw food in the refrigerator or microwave and marinate in the refrigerator.

Procedure

1. Ask students what comes to mind when they hear the words food safety, and jot some of their ideas on the board.
 - a. Discuss an example of safe food handling practices at a picnic. To provide students with background information on the topic visit www.foodsafety.gov/blog/perfectfood.html and compare the website information with students' initial ideas about food safety.
2. Next, tell students that you will read a scenario to them about a group of friends who go on a picnic. Instruct students to pay close attention to food safety issues as you read the story aloud.
 - a. After reading *Perils at the Picnic* to the class, ask students what they noticed about food safety at the picnic. Ask students if they would have done anything differently and why.
 - b. Organize students into groups of 3-4 and pass out *Perils at the Picnic* along with the accompanying *Cracking the Case* questions. Have each group brainstorm answers to the *Cracking the Case* questions. Review answers as a class.
3. Show students the *Food Safety Sleuths* PowerPoint presentation. Students should use the *Food Safety Sleuths* recording sheet to take notes.
 - a. At the end of the presentation, have students break into groups to come up with a catchy rhyme or song to remember the four steps for food safety. Clean, Separate, Cook, and Chill.
4. Explain to students that they will be conducting an experiment to learn how hand-washing affects the presence of bacteria on their hands. Organize students into groups of 3-4 and instruct them to brainstorm methods they could use for testing the effects of hand-

Food Safety Sleuths

Food Safety Specialist

washing on the presence of bacteria. Groups should write down their ideas about experiment set-up and should share them in a class discussion.

- a. After the class discussion on experimental design, distribute the *Hands On!* lab to each student and go over the directions as a class. Explain that this is one example of how a hand-washing experiment could be carried out and discuss its similarities to ideas that groups had while brainstorming experiment set-ups.
 - b. Demonstrate the proper sterile technique for inoculating the nutrient agar plates.
5. Instruct students to design a *slide show, video, poster, or brochure* describing food handling and preparation techniques. Students should use data from their own experiments as well as facts from research. Review the presentation rubric found on page 51 with the students.

Variations

- ▶ Allow students to alter the *Hands On!* lab experiment by culturing swabs from raw and cooked chicken or beef.
- ▶ Use Glo Germ™ lessons and products to teach proper hand-washing techniques, www.glogerm.com.

Extensions

- ▶ Suggest a focus group study on food safety for pets.
- ▶ Invite a guest speaker from a local supermarket, restaurant, or food distribution businesses to make a presentation to the students about their food safety programs and career opportunities in their fields.
- ▶ Have students research modern food preservation techniques such as canning, freezing, dehydrating, and pasteurization and compare and contrast them to historic techniques.
- ▶ Research historical food contamination tragedies.
- ▶ Watch food safety videos from the USDA. From the YouTube home page, type in *cook it safe*.

Food Safety Sleuths

Food Safety Specialist

ELL Adaptations

- ▶ Use visuals to show images of proper food safety procedures.
- ▶ Demonstrate lab procedures and show examples of completed lesson tasks.
- ▶ Use a word wall to chart different types food storage, handling, and preparation techniques.
- ▶ Do a computer search at *www.AskKaren.gov* and select the En Español option.

Hands On! Lab

Name: _____

Introduction

Hand-washing is an easy way to help prevent the spread of foodborne illness, flu, and the common cold. You will carry out an experiment to investigate hand-washing and hand sanitizer's affect on the presence of bacteria on your hands.

The Center for Disease Control recommends washing your hands:

- ▶ Before, during, and after preparing food
- ▶ Before eating food
- ▶ Before and after caring for someone who is sick
- ▶ After using the restroom, blowing your nose, coughing, or sneezing
- ▶ After touching animals, feed, waste, or garbage

To properly wash your hands:

1. Apply soap under clean, running water and lather up your hands including the back, front, between fingers, and under nails.
2. Continue washing hands for 20 seconds or for the time it takes you to sing the happy birthday song twice.
3. Rinse hands and dry with a clean towel or air dry. It is very important not to contaminate your clean hands by drying them on a dirty towel.

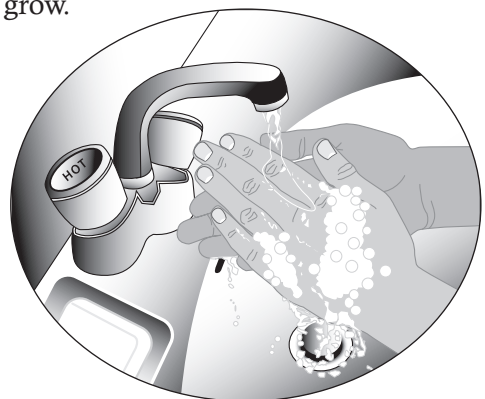
If soap and water isn't available:

- ▶ Use a hand sanitizer containing at least 60 percent alcohol.
- ▶ Apply hand sanitizer to palm and rub over surface of both hands until dry.

In this lab, you will use nutrient agar plates to investigate the presence of bacteria on your hands. Nutrient agar is a gelatin-like substance commonly used to grow bacterial cultures. The nutrient agar provides bacteria with the nutrients and moisture they need to survive. After inoculating the agar plates, you will put them in a warm place for several days to allow bacterial cultures to grow.

Group Materials

- ▶ 4 sterile nutrient agar plates
- ▶ Clear tape
- ▶ Resealable plastic bag
- ▶ Permanent marker
- ▶ Heat lamp or incubator (optional)
- ▶ Soap, water, and paper towels
- ▶ Hand sanitizer



Hands On! Lab *(continued)*

Lab Directions

Work in groups of three to four. Obtain the listed materials. Do not open the lid to the agar plates yet. Doing so can contaminate them with airborne particles. Lids should only be opened long enough to inoculate the plates with your finger as instructed below.

On the bottom of the agar plates use a permanent marker to label the plates:

- ▶ Control
- ▶ Unwashed
- ▶ Soap and water
- ▶ Sanitizer

1. One group member should not wash their hands prior to the experiment. Carefully open the agar plate labeled “Unwashed” and gently swipe the surface of the agar with the unwashed index finger. Do not poke a hole into the agar as it may break apart. Quickly replace the lid to the agar plate and set the plate aside.
2. One group member should carefully follow the hand-washing directions listed at the beginning of the lab. Do not touch anything after washing hands. Have another group member remove the lid off the agar plate labeled “Soap and Water.” The group member with the washed hands should then gently swipe the surface of the agar with a clean index finger. Do not poke a hole into the agar as it may break apart. Quickly replace the lid to the agar plate and set the plate aside.
3. One group member should carefully follow the hand sanitizer directions listed at the beginning of the lab. Do not touch anything after using hand sanitizer. Have another group member remove the lid off the agar plate labeled “Sanitizer.” The group member with the sanitized hands should then gently swipe the surface of the agar with a sanitized index finger. Do not poke a hole into the agar as it may break apart. Quickly replace the lid to the agar plate and set the plate aside.
4. Do not open the lid to the agar plate labeled “Control.” This plate will not be inoculated.
5. Secure the lids to your agar plates with two pieces of tape.
6. Label a resealable plastic bag with your group name. Place each agar plate upside down in the plastic bag. This will keep any condensation from falling onto the agar surface.
7. Place the bag with the agar plates in a warm area. The ideal temperature is around 90 degrees Fahrenheit. If this is not possible, give the bacterial cultures a few more days to develop and observe over the course of five to seven days.

Lab Report

Purpose: What do you want to learn?

Hypothesis: What do you predict will happen?

Hands On! Lab *(continued)*

Nutrient Agar Plate Observations

Carefully note the appearance of bacterial colonies on your agar plates. Colonies are individual organisms of the same species living together. Bacterial colonies are visible as clusters. Note the *size, color, shape, and any other defining characteristics*.

	Description		
Plate	Day 1 after inoculation	Day 3 after inoculation	Day 5 after inoculation
Control			
Unwashed			
Soap and Water			
Hand Sanitizer			

Questions

1. What was the function of your control?
2. Which agar plate grew the most bacterial colonies? Why do you think it grew more bacteria than the other plates?

Hands On! Lab *(continued)*

3. Was your hypothesis proved or disproved?
4. Explain any differences in the bacterial cultures on the hand sanitizer and soap and water agar plates. Which is a better method for cleaning your hands?
5. From this experiment, what can you conclude about the effectiveness of hand-washing with soap and water and using hand sanitizer to reduce the bacteria present on your hands?
6. How would you do this experiment differently if you carried it out again?

Food Safety Sleuths

Name: _____

Type	Description	Drawing	Sources	Symptoms
Bacteria				
Viruses				
Parasites				

1. What causes foodborne illness?

2. What can you do to prevent foodborne illness?

Safe Food Handling and Preparation Presentation Grading Rubric

Student's Name _____

Circle presentation type: video, poster, slide show, brochure

Category	4	3	2	1
Proofreading	There are no spelling or grammatical mistakes	There are one or two spelling or grammatical mistakes	There are two or three spelling or grammatical mistakes	There are several spelling or grammatical mistakes
Writing Mechanics	Capitalization and punctuation are correct throughout the presentation	There are one or two capitalization or punctuation errors in the presentation	There are two or three capitalization or punctuation errors in the presentation	There are several capitalization or punctuation errors in the presentation
Content Accuracy	All facts are accurate	99-90% of the facts are accurate	89-80% of the facts are accurate	Fewer than 80% of the facts are accurate
Attractiveness & Organization	The presentation has exceptionally attractive formatting and well-organized information.	The presentation has attractive formatting and well-organized information	The presentation has well-organized information	The presentation's formatting and organization of material are confusing
Sources	Sources are documented for 95-100% of facts and graphics	Sources are documented for 94-85% of facts and graphics	Sources are documented for 84-75% of the facts and graphics	Sources are not documented for many facts and graphics
Knowledge Gained	All students in group can answer all questions related to the presentation	All students in group can answer most questions related to the presentation	Most students in group can answer most questions related to the presentation	Several students in group have little knowledge about the presentation
Graphics/Pictures	Graphics go well with the text and there is a good mix of text and graphics	Graphics go well with the text, but there are so many that they distract from the text	Graphics go well with the text, but there are too few and presentation is "text-heavy"	Graphics do not go with the text or appear to be randomly chosen

Total Points Earned: _____

Answers to Commonly Asked Questions

What is the difference between food science and nutrition?

Food science is the science and technology that is involved in transport and processing of food from farms, ranches, oceans and other waterways to our grocery stores, restaurants, and home kitchens. Food science includes specialty fields such as food safety procedures and research, biotechnology to increase nutritional content and create new flavors, sensory science to carry out consumer research, and engineering to develop methods of processing foods. Nutrition is the study of vitamins and minerals in foods and the composition of a person's overall diet and its affect on their health.

What can a person do with a degree in food science?

The food industry is worldwide. Food science graduates may work for private companies or government agencies. Even NASA and Disney employ food scientists. Careers range from quality control, sensory science, product development, market research, microbiology, production, packaging, transportation systems, and many more.

What are some examples of courses that a student majoring in food science would take?

Some examples of courses could include: food product development field study, introduction to food preservation, food chemistry, malting and brewing science, food microbiology, introduction to food enzymology, food freezing, and new food product ideas.

Where can I go to find information about colleges offering food science programs?

The Institute of Food Technologists has a Web page with listings and links to approved undergraduate programs at www.ift.org/community/students/approved-undergrad-programs.aspx.

Where can I find a food scientist to talk to?

The knowledge center page on the Institute of Food Technologists has a tab to "Find a Food Scientist." www.ift.org/knowledge-center.aspx

Teacher Resources and References

Agricultural Organizations

General

American Farm Bureau Foundation for Agriculture

600 Maryland Avenue SW, Suite 1000W

Washington, DC 20024

Phone: (202) 406-3700

Toll free: (800) 443-8456

E-mail: curtism@fb.org

Website: www.agfoundation.org

Website: www.myamericanfarm.org

California Foundation for Agriculture in the Classroom

2300 River Plaza Drive

Sacramento, CA 95833-3293

Phone: (916) 561-5625

Toll free: (800) 700-AITC

E-mail: info@LearnAboutAg.org

Website: www.LearnAboutAg.org

National 4-H Cooperative Curriculum System, Inc.

405 Coffey Hall

1420 Eckles Avenue

St. Paul, MN 55108-6068

Phone: (612) 624-4900

Toll free: (800) 876-8636

E-mail: shopext@umn.edu

Website: www.n4hccs.org

Website: www.4-hmall.org

University of California

Agriculture & Natural Resources Cooperative Extension

Website: ucanr.edu

United States Department of Agriculture

U.S. Department of Agriculture

1400 Independence Ave., S.W.

Washington, DC 20250

Phone: (202) 720-2791

Website: www.usda.gov

Teacher Resources and References

Food Science and Technology Organizations

Institute of Food Technologists

525 W. Van Buren, Ste. 1000

Chicago, IL 60607

Phone: (312) 782-8424

E-mail: info@ift.org

Website: www.ift.org

United States Department of Agriculture

Food and Nutrition Information Center

National Agricultural Library

10301 Baltimore Avenue, Room 108

Beltsville, MD 20705

Phone: (301) 504-5414

E-mail: FNIC@ars.usda.gov

Website: www.fnic.nal.usda.gov/professional-and-career-resources/food-science-and-technology

California Colleges with Food Science Programs

Cal Poly San Luis Obispo

San Luis Obispo, CA 93407

Phone: (805)756-2660

E-mail: admissions@calpoly.edu

Website: www.foods.calpoly.edu

California Polytechnic State University Pomona

3801 West Temple Avenue

Pomona, CA 91768-2557

Phone: (909) 869-7659

Website: www.csupomona.edu/~hnfs

University of California, Berkeley

119 Morgan Hall

Berkeley, CA 94720-3104

Phone: (510) 642-6490

Website: www.berkeley.edu/academics/school.shtml



Teacher Resources and References

University of California, Davis
One Shields Avenue
Davis, CA 95616-8598
Phone: (530) 752-1465
Website: *foodscience.ucdavis.edu*

Teacher Resources and References

Related Websites

California Department of Food and Agriculture

www.cdfa.ca.gov

California Foundation for Agriculture in the Classroom

www.LearnAboutAg.org

Centers for Disease Control and Prevention: Food Safety

www.cdc.gov/foodsafety

Discovery Education: Food Science and Technology

school.discoveryeducation.com/foodscience

The Exploratorium: Science of Cooking

www.exploratorium.edu/cooking

Foodsafety.gov: Your Gateway to Federal Food Safety Information

www.foodsafety.gov

Food Safety Music

foodsafe.ucdavis.edu

Institute of Food Technologists

www.ift.org

Partnership for Food Safety Education

www.fightbac.org

United States Department of Food and Agriculture

www.usda.gov

University of California Agriculture and Natural Resources

www.ucanr.org

Utah Agriculture in the Classroom: Science in Your Shopping Cart

www.agclassroom.org/teacher/science/high_tech.pdf

Teacher Resources and References

Related Literature

DeGregori, Thomas. *Bountiful Harvest: Technology, Food Safety, and the Environment*. CATO Institute, 2002. The author expresses his opinion that technology, like an art, expresses the creativity of human beings and provides a world that is better fed. ISBN 978-1-930865-31-0

Satin, Morton. *Food Alert: The Ultimate Sourcebook for Food Safety*. Checkmark Books, 1999. Learn about the 20 most common causes of food contamination in your kitchen, steps you can take to lower the risk of foodborne illness, how to avoid eating contaminated food, and how to tell if you may be suffering from a foodborne illness. ISBN 978-0-8160-3935-7

Stille, Darlene R. *Lunch Lady Science*. Compass Point Books, 2012. This book uses fun examples and interactive content to trace food from its origin to our plates. Subject matter includes growing, cooking, and preserving food, digestion and nutrition, and more. ISBN 978-0-7565-4502-4

Young, Sarah. *Gourmet Lab: The Scientific Principles Behind Your Favorite Foods*. NSTA Press Book, 2011. Hands on, inquiry based, and relevant to every student's life, *Gourmet Lab* serves up a full menu of activities for science teachers of grades six through twelve. This collection of 15 hands-on experiments, each of which includes a full set of both student and teacher pages, challenges students to take on the role of scientist and chef, as they boil, bake, and toast their way to better understanding of science concepts from chemistry, biology, and physics. ISBN 978-1-936137-08-4

Matrix of Standards

6th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Common Core English Language Arts					
RST.6.3 Reading for Literacy in Science and Technology Subjects	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.	x	x	x	x
SL.6.1 Speaking and Listening	Engage effectively in a range of collaborative discussions with diverse partners on grade six topics, texts, and issues, building on others ideas and expressing their own clearly.	x	x	x	x
SL.6.2 Speaking and Listening	Interpret information presented in diverse media and formats and explain how it contributes to a topic, text, or issue under study.	x	x		x
SL.6.5 Speaking and Listening	Include multimedia components and visual displays in presentations to clarify information.	x	x	x	x
W.6.1 Writing	Write arguments to support claims with clear reasons and relevant evidence.	x			x
W.6.2 Writing	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	x			x
WHST.6.6 Writing for Literacy in History/Social Studies, and Technical Subjects	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.	x	x	x	x
WHST.6.7 Writing for Literacy in History/Social Studies, and Technical Subjects	Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.	x	x		x
WHST.6.8 Writing for Literacy in History/Social Studies, and Technical Subjects	Gather relevant information from multiple print and digital sources using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.	x	x		x

Matrix of Standards

6th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Common Core Mathematics					
6.EE.2a Expressions and Equations	Write expressions that record operations with numbers and with letters standing for numbers.			x	
6.EE.2c Expressions and Equations	Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems.	x	x	x	
Next Generation Science Standards					
ESS3.C Human Impacts on Earth Systems	Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.		x	x	
MS-ETS1.A Defining and Delimiting an Engineering Problem	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.		x	x	x
MS-ETS1.B Developing Possible Solutions	A solution needs to be tested, and then modified on the basis of the test results in order to improve it.	x	x	x	x
MS-ETS1.C Optimizing the Design Solution	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process, that is, some of those characteristics may be incorporated into the new design.	x	x		
MS-ETS1-1 Engineering Design	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		x	x	
MS-ETS1-2 Engineering Design	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		x	x	

Matrix of Standards

6th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Next Generation Science Standards (cont.)					
MS-ETS1-3 Engineering Design	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		x		x
MS-ETS1-4 Engineering Design	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		x		
MS-LS2.A Interdependent Relationships in Ecosystems	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources.				x
Visual and Performing Arts Content Standards					
Aesthetic Valuing 4.3	Develop specific criteria as individuals or in groups to assess and critique works of art.	x	x		

Matrix of Standards

7th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Common Core English Language Arts					
RST.7.3 Reading for Literacy in Science and Technical Subjects	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.	x	x	x	x
SL.7.1 Speaking and Listening	Engage effectively in a range of collaborative discussions with diverse partners on grade seven topics, texts, and issues, building on others ideas and expressing their own clearly.	x	x	x	x
SL.7.2 Speaking and Listening	Analyze the main ideas and supporting details presented in diverse media and formats and explain how the ideas clarify a topic, text, or issue under study.	x	x		x
SL.7.5 Speaking and Listening	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	x	x	x	x
W.7.1 Writing	Write arguments to support claims with clear reasons and relevant evidence.	x			x
W.7.2 Writing	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	x			x
WHST.7.6 Writing for Literacy in History/Social Science, Science and Technical Subjects	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.	x	x	x	x
WHST.7.7 Writing for Literacy in History/Social Science, Science and Technical Subjects	Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.	x	x		x

Matrix of Standards

7th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Common Core English Language Arts (cont.)					
WHST.7.8 Writing for Literacy in History/Social Science, Science and Technical Subjects	Gather relevant information from multiple print and digital sources using search terms effectively: assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.	x	x		x
Common Core Mathematics					
7.RP.3 Ratios and Proportional Relationships	Use proportional relationships to solve multistep ratio and percent problems. Examples: tax, markups and markdowns.	x		x	
7.EE.4a Expressions and Equations	Solve word problems leading to equations of the form $px + q = r$			x	
Next Generation Science Standards					
MS-LS2.A Interdependent Relationships in Ecosystems	Organisms, and populations or organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources.				x
MS-ETS1.A Defining and Delimiting an Engineering Problem	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.		x	x	x
MS-ETS1.B Developing Possible Solutions	A solution needs to be tested, and then modified on the basis of the test results in order to improve it.	x	x	x	x
MS-ETS1.C Optimizing the Design Solution	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process, that is, some of those characteristics may be incorporated into the new design.	x	x		

Matrix of Standards

7th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Next Generation Science Standards (cont.)					
MS-ETS1-1 Engineering Design	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		x	x	
MS-ETS1-2 Engineering Design	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		x	x	
MS-ETS1-3 Engineering Design	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		x		x
MS-ETS1-4 Engineering Design	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		x		
Visual and Performing Arts Content Standards					
Aesthetic Valuing 4.4	Develop and apply specific and appropriate criteria individually or in groups to assess and critique works of art.	x	x		

Matrix of Standards

8th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Common Core English Language Arts					
RST.8.3 Reading for Literacy in Science	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.	x	x	x	x
SL.8.1 Speaking and Listening	Engage effectively in a range of collaborative discussions with diverse partners on grade 8 topics, texts, and issues, building on others ideas and expressing their own clearly.	x	x	x	x
SL.8.2 Speaking and Listening	Analyze the purpose of information presented in diverse media and formats and evaluate the motives behind its presentation.	x	x		x
SL.8.5 Speaking and Listening	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.	x	x	x	x
W.8.1 Writing	Write arguments to support claims with clear reasons and relevant evidence.	x			x
W.8.2 Writing	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	x			x
WHST.8.6 Writing for Literacy in History/Social Science, Science and Technical Subjects	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.	x	x	x	x

Matrix of Standards

8th Grade

WHST.8.7 Writing for Literacy in History/Social Science, Science and Technical Subjects	Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.	x	x		x
WHST.8.8 Writing for Literacy in History/Social Science, Science and Technical Subjects	Gather relevant information from multiple print and digital sources using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.	x	x		x
Common Core Mathematics					
Geometry 8.G.9	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.		x		
Next Generation Science Standards					
MS-LS2.A Interdependent Relationships in Ecosystems	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources.				x
MS-ETS1.A Defining and Delimiting an Engineering Problem	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.		x	x	x
MS-ETS1.B Developing Possible Solutions	A solution needs to be tested, and then modified on the basis of the test results in order to improve it.	x	x	x	x
MS-ETS1.C Optimizing the Design Solution	Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process that is, some of those characteristics may be incorporated into the new design.	x	x		
MS-ETS1-1 Engineering and Design	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		x	x	
MS-ETS1-2 Engineering and Design	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		x	x	
MS-ETS1-3 Engineering and Design	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		x		x
www.LearnAboutAg.org					

Matrix of Standards

8th Grade

California Standards	Description	Mix It Up! <i>Food Scientist</i>	Cruisin' for a Bruisin' <i>Food Packaging Specialist</i>	Food on the Move <i>Food Transportation Specialist</i>	Food Safety Sleuths <i>Food Safety Specialist</i>
Next Generation Science Standards (cont.)					
MS-ETS1-4 Engineering and Design	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		x		
ESS3.C Human Impacts on Earth Systems	Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.		x	x	
Visual and Performing Arts Content Standards					
Aesthetic Valuing 4.4	Develop and apply specific and appropriate criteria individually or in groups to assess and critique works of art.	x	x		
Connections, Relationships, Applications 5.3	Demonstrate an understanding of the effects of visual communication media on all aspects of society.	x			

Glossary

Agar plate: a Petri dish containing a gel with nutrients for growing bacterial cultures or small plants.

Alfalfa: a type of plant grown as food for farm animals such as cattle and horses.

Apiary: A place where hives of honeybees are kept.

Aroma: the smell or odor of something. For example, the aroma of fresh baked cookies.

Bacteria: single celled, microscopic organisms that live in soil, water, the ocean, and in other organisms. Many are beneficial, but some are harmful.

Bacterial colony: a visible cluster of thousands of cells that grew from the original bacterial cell. One single bacterium is invisible to the naked eye, but a colony of many bacteria is visible without using a microscope.

Bedding plants: plants that are grown in garden beds, usually for their display of flowers. They are usually grown as annuals and die at the end of the growing season.

Biodegradable: the ability of an object to be broken down through the action of microorganisms. For example, paper bags are biodegradable, plastic bags are not.

Bulls: male cattle that have reached sexual maturity, usually used for breeding.

Cattle and calves: Cattle are adult beef cattle and calves are young beef cattle.

Climate: the usual weather conditions in a certain region.

Commodity: something that is bought and sold. Examples of agricultural commodities include milk, alfalfa, grapes, almonds, and poultry.

Contaminate: to make something dirty or impure by accidentally or purposely adding something harmful.

Glossary

Cows: mature female cattle.

Crop: a plant or plant product that is grown by farmers.

Cut flowers: flowers grown to be cut and sold in flower markets, floral design shops, and grocery stores.

Farm: an establishment that produces and sells agricultural products.

Feeder cattle: cattle that are being raised from calves until they are sold to the market or feed lot.

Foliage plants: plants grown to be sold and planted as landscaping.

Food safety: the handling, preparation, and storage of food through scientifically tested methods that prevent foodborne illness.

Food science: the study of the biological, chemical, and physical nature of food components and the technology to bring safe and wholesome foods from the farm to consumers' kitchens.

Foodborne illness: any illness resulting from the consumption of food contaminated with viruses, parasites, or pathogenic bacteria.

Forest product: product from trees such as lumber for building homes, pulp for paper, and bark for landscaping.

Hen: adult female chicken.

Heifers: young female cattle that have not yet given birth to their first calf.

Horticulture: the science and art of growing plants.

Inoculate: to introduce a microorganism into a suitable growing medium.

Irrigation: the watering of land from sources other than precipitation from the atmosphere. For example, when you water your lawn with a sprinkler, you are irrigating your lawn.

Glossary

Livestock: domesticated animals raised in an agricultural setting to produce commodities such as food, fiber, and labor. For example, cattle, goats, and pigs.

Microorganism: any organism, such as a bacterium, protozoan, or virus, of microscopic size.

Nursery products: plants grown for landscaping and gardening purposes.

Parasite: an animal or plant that lives in or on another animal or plant in order to get food and protection.

Pasture: area of land where certain types of plants such as grass are grown for animals to feed on. Pasture may be irrigated.

Pathogen: something that causes disease or illness.

Poultry: birds that are raised on farms for their eggs or meat. Examples are chickens and turkeys.

Processing tomatoes: tomatoes grown to produce products such as tomato sauce rather than being sold as fresh tomatoes.

Pullet: young female chicken.

Ranch: A large farm for the rearing of livestock.

Range: an open area of land where livestock may roam and feed.

Rooster: adult male chicken usually kept for breeding.

Specialty crop: fruits, tree nuts, vegetables, herbs, spices, nursery, floriculture, and horticulture crops that are not considered staple foods.

Steers: castrated male cattle.

Stocker cattle: heifers and/or steers being raised on pasture or other forage for later sale.

Glossary

Texture: the texture of food describes how it feels in the mouth. For example: crunchy, chewy, soggy, creamy.

Timber: trees grown to produce lumber.

Topography: the features of land in area. For example, mountains, valleys, lakes, and rivers.

Virus: extremely small organism that causes disease and can be spread from one person or animal to another.

Woody ornamentals: trees and shrubs grown for landscaping or decorative uses.