Five **Fun Facts** About California Agriculture!

- California has been the nation’s top agricultural state for more than 50 years. California agriculture generates approximately $54 billion a year, more than any other state.
- More than 90% of California farms are family farms or partnerships.
- California grows more than 400 agricultural commodities.
- Milk is California’s most valuable commodity. Milk production generated $9.36 billion in 2014.
- Over a third of US vegetables and two-thirds of US fruits and nuts are produced in California.

Check out these **Fun Resources**!

- **What’s Growin’ On?**: The 16-page student newspaper provides reading and activities, geared for grades 3-8. One copy of our recent editions is included in the back pocket. Request class sets while supplies last at LearnAboutAg.org/wgo.
- **Fact and Activity Sheets**: We offer more than 30 fact sheets, covering a wide range of agricultural topics. Download or request print copies at LearnAboutAg.org/factsheets.
- **Invasive Species**: The Invaders introduces six invasive species threatening California agriculture. Explore more in-depth resources at LearnAboutAg.org/invasivespecies.
- **Plant Nutrients**: Fact and activity sheets explain the essential plant nutrients (NPK)! Explore plant science resources for all ages at LearnAboutAg.org/resources/learn_plant.cfm.
- **Food Safety from Farm to Fork**: This interdisciplinary educational unit is all about food safety. Explore more units and lesson plans at LearnAboutAg.org/lessons.
- **Ag-Bites and WE Gardens**: These one-page resources promote hands-on learning. See the full sets at LearnAboutAg.org/agbites and LearnAboutAg.org/wegarden.
- **Farming is Everywhere**: This educational coloring book is fun for younger students! The coloring book is available for download at LearnAboutAg.org/resources/teaching.cfm.
- **Other Resources**: We’ve included resources from ChooseMyPlate.gov and FruitsAndVeggieMoreMatters.org. The kiwifruit resource (in the November section) was provided by HarvestOfTheMonth.com, a great source for nutrition education resources. The apple lesson (*A is for Apples*) was provided through the National Agricultural Literacy Curriculum Matrix, a collection of materials available at AgClassroom.org. For students interested in agricultural career opportunities, check out AgExplorer.com.

Questions?
Contact Jennifer@LearnAboutAg.org or 916-561-5625
### California Agricultural Fact and Activity Sheets

Information compiled by California Foundation for Agriculture in the Classroom

The California-specific fact sheets include information about natural resources or commodity production, history, nutrition, top producing counties, and economic values. The activity sheets provide specific lesson ideas and fun facts for each topic. Download or request print copies at LearnAboutAg.org/factsheets.

- **Agricultural Water**
- **Alfalfa**
- **Almonds**
- **Artichokes**
- **Asparagus**
- **Avocados**
- **Beef**
- **Cantaloupes**
- **Cherries**
- **Citrus Fruits**
- **Cling Peaches**
- **Corn**
- **Cotton**
- **Cut Flowers**
- **Dairy**
- **Dried Plums**
- **Dry Beans**
- **Eggs**
- **Forest Resources**
- **Fresh Carrots**
- **Invasive Species**
- **Mushroom**
- **Pears**
- **Pistachios**
- **Plant Nutrients - Nitrogen**
- **Plant Nutrients - Phosphorus**
- **Plant Nutrients - Potassium**
- **Processing Tomato**
- **Rice**
- **Spinach**
- **Strawberries**
- **Table Grapes**
- **Walnuts**

### Top 10 Ways to Use Agricultural Fact and Activity Sheets

<table>
<thead>
<tr>
<th>1. Ag Literacy Events</th>
<th>6. Agricultural Marketing</th>
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<tbody>
<tr>
<td>Information and fun activities for young students who are just starting to learn about agriculture.</td>
<td>Students use the information on fact sheets to develop jingles, billboards, and commercials. Discuss the importance of a strong and positive marketing campaign for agriculture.</td>
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<tr>
<td>Assign each student a different commodity or natural resource. Students design a weekly bulletin board and engage their peers in a related activity.</td>
<td>Fact sheets are a wellspring of ideas for researching and experimenting about different agricultural commodities and natural resources.</td>
</tr>
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<tr>
<th>3. World Geography Connection</th>
<th>8. Language Arts/English Connection</th>
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<tr>
<td>Where did these California commodities originate? Students create a world map, illustrating country of origins.</td>
<td>Students read the front of the fact sheet and demonstrate their reading comprehension by how well they answer the “fantastic facts” questions. Students select an agricultural topic and write a research paper using proper grammar and citing of references.</td>
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<tr>
<td>Highlight the dates mentioned on each commodity sheet. Create a timeline that goes all around the classroom, using words and images to record these significant moments in agriculture.</td>
<td>Students analyze the nutritional values of various agricultural commodities and explain the human body’s use of specific vitamins. Students identify where the commodities fit in the different food groups.</td>
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<th>5. Math Connection</th>
<th>10. Add some spice to your lessons!</th>
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<tr>
<td>Students use numbers found within the facts sheets to create an appropriate graph of their choice. For example, create a pie chart representing the percentage of clingstone peaches that are used for fruit cocktail, are canned and are eaten fresh.</td>
<td>Find a new method for teaching everything from alfalfa to water.</td>
</tr>
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</table>
Sources – California’s water supply averages 194.7 million acre-feet per year, statewide. This water comes from rain and snowfall and the Colorado and Klamath rivers. From this supply, the majority is consumed by natural vegetation, leaving 82 million acre-feet available for dedicated use. During an average water-supply year, California farmers and ranchers consume 33.1 million acre-feet of water to grow their crops. Other consumptive uses include the environment at 38.7 million acre-feet and 8.0 million acre-feet for municipal and industrial uses.

The major projects that have been the primary sources of stored water include the Central Valley Project (CVP), State Water Project (SWP), Coachella Canal, All-American Canal, and the Klamath Basin. Construction of the CVP began in 1937 and for the SWP in 1957, with full SWP funding approved in 1960. The delivery of water originating in northern California from the CVP and SWP has been reduced in recent years due to environmental regulations that govern the delivery of water through the Sacramento-San Joaquin Delta.

Distribution – Water is available through natural precipitation such as rain and snow. It is then transported throughout the state’s numerous waterways, including creeks, streams, lakes, and rivers. Other water is stored underground in porous rock and soil (also called aquifers) and brought to the surface by wells and pumps. Approximately 30 percent of the water supply for farms, homes and businesses comes from groundwater.

Two-thirds of the demand for water comes from the Southern one-third of the state while two-thirds of the precipitation and water storage are in the Northern one-third, creating significant challenges for water distribution.

History – The history of California agriculture and water development are intertwined. The first California agricultural water delivery system was built at Mission San Diego Acala. With the Gold Rush, the state’s demand for food grew with its population. As early as 1865, private companies began constructing canals in the Central Valley to irrigate crops. In 1877, the State Legislature passed the Wright Act, authorizing the formation of public irrigation districts. These agencies, formed by local citizens, are responsible for providing a steady, reliable supply of water for irrigation, flood control, recreation, human consumption, and other uses. In the twentieth century, the California Department of Water Resources and the United States Bureau of Reclamation also began storing water and delivering it to farms and cities. This large-scale development of water has allowed California to become a national and world leader in agriculture.

Irrigation Techniques – Simply stated, the term “irrigation” is the process of putting water into the soil to make plants grow. There are three basic ways to irrigate: surface, micro-irrigation, and sprinkler. Surface irrigation includes methods such as border-strip and furrow where water flows on top of the soil. Micro-irrigation techniques, such as drip, bubbler, spray, and subsurface drip, deliver a measured amount of water through an emitter located near each plant. Micro-irrigation techniques can be located above or below ground. Sprinkler irrigation includes the use of a mechanical device which sprinkles water over the crops and simulates rain.

The method of irrigation used depends on many factors including geographical location, crop type, soil type, climate, and economics. Farmers often use laser-leveling to make their fields level or sloped for efficient irrigation.

Economic Value – Water is an essential component to life and the economy of California. It is vital to the success of California’s $44.7 billion agricultural industry. California has led the nation in farm production every year since 1946. Each of the more than 400 crops grown in California depends upon the availability of water—from the fruits, vegetables and meats people eat to the cotton and wool clothing people wear and the forest and floral products people use and enjoy.

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Website: www.farmwater.org
### Lesson Ideas

- Evaluate examples of surface, micro and sprinkler irrigation. Discuss how new technology has affected water use and conservation.
- Examine the effect of watering duration and frequency on plant growth by manipulating one variable. Beginning with the same amount of water, irrigate one plant with more water less often and one plant with less water more often.
- Fill three plastic cups; one with soil, one with gravel, and one with sand. Predict which cup will hold the most water. Pour water into the cups to test your predictions.
- Discuss the water cycle and how evaporation, condensation, transpiration and precipitation affect agriculture.
- Place a rain gauge outside your classroom and record the precipitation in your area.
- Research the seasonal rainfall averages in your area. What crops could be supported by this rainfall average?
- Locate newspaper articles that cover local, state and federal water issues. Discuss how they affect the students.

### Fantastic Facts

1. List the three main types of irrigation techniques.
2. Where does most precipitation occur in California?
3. True or false? California’s agricultural industry is dependent on the availability of water.
4. In acre-feet, what is the average annual rainfall and snowfall in California?
5. What term means “putting water in the soil to make plants grow?”
6. True or false? Rivers, creeks, dams, canals and pumps are used to store and transport water.
7. Where was the first water delivery system established for California agriculture?
8. How are fields leveled precisely for appropriate irrigation?

- Surface, micro-irrigation, sprinkler
- Northern California
- True
- 200 million acre-feet
- Irrigation
- True
- Mission San Diego Acala
- With lasers

### Lesson Plan: Waterways

**Introduction:** In this activity students will learn about the sources of water in their community as well as perform an activity that teaches about water delivery systems and irrigation techniques. Students will use innovative processes to deliver water from a source (a bucket) to a field (an aluminum pie plate) and then distribute it throughout their field (pie plate full of dirt) using an irrigation technique.

**Materials:** Buckets, plastic rain gutters, aluminum pie plates, straws, duct tape, sponges, old rags, PVC pipe tubing and fittings, writing paper, butcher paper, markers and other supplies of your choosing.

**Procedure:**

1. Divide students into groups. Have them discuss and write down where they think the water for their community comes from. Do they think the water used for agricultural production in the community comes from the same sources? Discuss their thoughts and clarify the information with facts you have gathered from your local water agencies.

2. Explain that once the water is available, it must be delivered to cities and farmlands. Show the students the supplies they have to work with—the bucket of water is the source and the straws, sponges, pipe fittings, etc. are the equipment used to deliver the water to the farm or city (the aluminum pie plate). Have the students design and build a way to deliver the water from the source to the city or farm, which is a significant distance from the source.

3. Once the students have created a way to transport the water from the source to the city or farm, add soil, which represents the farm or garden that needs irrigating, to the pie plate. Have the students devise a way to efficiently irrigate this crop or garden.

4. After completing the experiment, have each group draw a picture of their model on butcher paper and share their successes and challenges with the class. Compare and contrast the various delivery and irrigation techniques.

5. Invite a local water district representative or a farmer to visit your class to discuss how local water is delivered to homes and farms and how the farms are irrigated.
Here’s the dirt…

Invasive species are insects, plants, animals, and diseases that are moved by nature or people into an ecosystem where they have not been previously found. They often have no natural predators to control their numbers and as a result, they outcompete or kill native plants and animals.

Why do we care?

Invasive species can destroy agriculture crops, eliminate jobs, threaten food supplies, and damage our backyard gardens and wilderness areas. On average, a new pest is introduced into California every 60 days. Invasive species cost California’s agriculture industry about $3 billion per year in control methods and crop losses.

Research one of the invasive species above and find its country of origin. Write a creative story that tells how the invasive species made its way to California and what agricultural or environmental damage it created once it got here. Include information on methods used to prevent the spread of the invasive species.

WHO ARE THEY?

**Asian Citrus Psyllid**

- Spreads huanglongbing disease that causes bitter fruit and kills citrus trees.
- Photo credit: David Hall, USDA Agricultural Research Service, Bugwood.org

**European Grapevine Moth**

- Caterpillars feed on grapes and grape flowers, destroying the harvest.
- Photo credit: Todd Gilligan, CSU, Bugwood.org

**Mediterranean Fruit Fly**

- Maggots feed inside fruit and cause it to rot.
- Photo credit: Scott Bauer, USDA Agricultural Research Service, Bugwood.org

**False Codling Moth**

- Its caterpillars burrow into fruit and eat it.
- Photo credit: Pest and Diseases Image Library, Bugwood.org

**Varroa Mite**

- A tiny parasite that feeds on honey bees.
- Photo: Scott Bauer, USDA Agricultural Research Service, Bugwood.org

**Oriental Fruit Fly**

- Can infest new areas quickly because of how far they fly.
- Photo credit: Florida Department of Agriculture and Consumer Services Bugwood.org

**European Grapevine Moth**

- Caterpillars feed on grapes and grape flowers, destroying the harvest.
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**Oriental Fruit Fly**

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- Photo credit: Florida Department of Agriculture and Consumer Services Bugwood.org

How Can You Help?

- If you travel out of the area, don’t bring home food, plants, animals, firewood, or other material that might carry an invasive species.
- Do not release pets such as hamsters, gold fish, and reptiles into the wild.
- Plant only native plants in your yard.

Detective Dogs!

Dogs, trained to detect agricultural products in shipments play an important role in preventing the spread of invasive species. These dogs work with their handlers in airports, shipping centers, ports, and state and country borders. When the dogs smell agricultural products like fruits, vegetables, plants, soil, wood, or certain insects, they scratch at the container. The container is then opened and inspected by a biologist to check for invasive species. If any are found they are properly disposed of or shipped back to the person who sent the package. After the dogs work for a few hours, they have mandatory play or nap time!

Meet the detective dogs working in California by visiting www.cdfa.ca.gov/plant/dogteams.

Farmer Fiona and her family grow oranges on their 100 acre farm. For this example, we will say the annual cost to grow oranges is $6,000 per acre. This includes watering, pruning, weed, pest, and nutrient management, along with equipment maintenance, and hired farm workers.

Each year, Fiona’s farm usually produces 550 cartons of oranges per acre that may sell for around $15 per carton. However, an insect called the Asian citrus psyllid invaded the orchard and infected 50% of the trees with the huanglongbing disease. In order to prevent the spread of the disease, the infected trees must be removed. On a separate piece of paper, explain the economic impact of this invasive species on Fiona’s farm. Do the math to find out how much the farm would have made selling oranges if the orchard had not been infested by the Asian citrus psyllid.

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Plant Utilization – Nitrogen is one of the 17 chemical elements required for plant growth and reproduction. Nitrogen is in chlorophyll, a green chemical which allows plants to capture energy from the sun and make food for themselves in a process called photosynthesis. It is also the basic element of plant and animal proteins, including the genetic material DNA and RNA, and is important in all phases of plant growth.

Production – Nitrogen is an abundant element on and around Earth—approximately 78 percent of the Earth’s atmosphere is nitrogen gas (N₂). As with all plant nutrients, however, nitrogen must be in specific forms to be utilized by plants. Converting N₂ into nitrogen plants can use is called nitrogen fixation. Most often, nitrogen gas is converted into plant available nitrogen by using complex chemical processes or nitrogen-fixing bacteria.

Most manufactured nitrogen fertilizers begin as ammonia. At temperatures of 400°C - 500°C and great pressure, nitrogen from the air and hydrogen from natural gas combine to produce ammonia. The ammonia can be used directly or further processed into other nitrogen fertilizers. Legumes such as beans and alfalfa grow specialized nodules on their roots. Rhizobia, nitrogen-fixing bacteria, live in these root nodules and convert atmospheric nitrogen into nitrogen plants can use. Farmers take advantage of this unique symbiotic relationship by periodically growing legumes in nitrogen-deficient soil to naturally boost nutrient levels.

Forms – In the soil, nitrogen exists in different forms, which interact with one another and with plants, animals and microorganisms. Most crops use nitrogen rapidly, therefore, farmers and home gardeners often supply nitrogen to the plants in a variety of ways, including the application of manufactured fertilizers, applying composts and manures, and growing legumes in rotation with other crops.

Plants absorb nitrogen in the forms of (NO₃⁻) or ammonium (NH₄⁺) ions, both of which are water-soluble. Nitrate ions are absorbed quickly by plant roots, but leach easily. Ammonium ions are attracted to soil particles and move slowly through the soil to plant roots. Commercial fertilizers, both dry and liquid, are available with various combinations of nitrate and ammonium ions, enabling farmers to manage their nitrogen application. Crop advisors monitor crops to ensure the crops receive optimum amounts of nitrogen.

History – Americans have fertilized their crops with nitrogen for centuries. Early colonists used animal manure, fish scrap, cottonseed meal, and tobacco stems as nitrogen fertilizer. Later, Americans imported nitrate of soda from Chile, rotated crops with legumes and used ammonium sulfate, a by-product of steel production. Many of these are still used today.

The process of synthesizing ammonia is considered one of the greatest chemical engineering feats. The process was first demonstrated in the laboratory in 1884, but it was not commercially feasible until 1913 in Germany. The first American ammonia plant was built in 1921. Nitrogen fertilizer production was minimal until after World War II, when the demand for food increased with an increase in human population. Improved nitrogen management is the focus of intensive research at both public and private research facilities.

Top Producing Regions – China is the world’s largest producer of nitrogen and phosphate fertilizers and Canada produces more potash fertilizer than any other country. Although the U.S. is the third largest producer of nitrogen fertilizers, we still import more nitrogen fertilizer than any other country. Natural gas prices rose from under $2/MMBtu in 1998 to over $10/MMBtu in 2008. Natural gas is a major feedstock for production of ammonia. During this same period 27 U.S. ammonia plants closed. Since 2008, four new ammonia plants have opened but the U.S. remains dependent on nitrogen imports. More than 60% of imported anhydrous ammonia is from Trinidad. Globally, wheat receives the largest share of nitrogen fertilizer at 18.1 percent, however, in the U.S. nearly half (49 percent) of all nitrogen fertilizer is applied to corn.

Economic Value – The economic value of the nitrogen industry is difficult to assess. Many people have businesses associated with replenishing agricultural soils with nitrogen, including those whose livelihoods depend on providing compost bins, soil amendments, and tools. Ammonia production adds $4 billion to the United States economy annually.

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For current California Standards please see LearnAboutAg.org/factsheets/
This is one in a series of fact sheets composed by the California Foundation for Agriculture in the Classroom (CFAITC). For additional educational materials: CFAITC, 2300 River Plaza Drive, Sacramento, CA 95833-3293 (916) 561-5625  (800) 700-AITC  Fax: (916) 561-5697
Email: info@learnaboutag.org  Website: www.LearnAboutAg.org  ©2014 California Foundation for Agriculture in the Classroom. All rights reserved.
Lesson Ideas

- Compare and contrast the nitrogen and water cycles.
- Make a poster of the nitrogen cycle using magazine pictures.
- Chart and compare the growth of plants which are fertilized with varying amounts of nitrogen fertilizer.
- Compare fertilizer labels for nitrogen content.
- Make compost at your school using garden, fruit and vegetable lunch waste.
- Identify plants which are legumes. Research how these plants make nitrogen available to other plants.
- Draw a picture of a plant and the plant’s need for nitrogen.
- Research the procedures and chemical equations used in ammonia fertilizer production.
- Compare and contrast the nitrogen content of various organic fertilizers, including steer manure, chicken manure and fish emulsion.
- Locate nitrogen on the periodic table of elements. Learn about its physical and chemical properties.

Fantastic Facts

1. What chemical is the basic ingredient in commercial nitrogen fertilizer production?
2. What color is associated with plants which contain the appropriate amount of nitrogen?
3. What kinds of plants contain microorganisms in their roots that convert nitrogen into a form other plants can use?
4. What are the two basic chemical formulas that show the forms in which plants can absorb nitrogen through their roots?
5. List one of the world’s top importers of nitrogen.
6. What form of nitrogen leaches rapidly?
7. Which states produce ammonia in the United States?

1) Ammonia 2) Green 3) Legumes, such as beans and alfalfa
4) NO₃⁻ and NH₄⁺ 5) United States 6) Nitrate (NO₃⁻) 7) None

Introduction: Substances added to improve the nutrient content of soils are called fertilizers. In this activity, students will make a liquid fertilizer called “manure tea” out of steer manure. The students will then design and perform an experiment to determine the optimum dilution of this nitrogen-rich fertilizer.

Materials: Store-bought steer manure (3 or 4 cups), coffee filter, five-gallon bucket with lid, water, string, index cards cut in half, stapler; tablespoon, corn seedlings and other supplies for student-designed experiment.

Procedure:

1. Write the term “manure tea” on the board. Obtain student ideas for its definition. Also discuss that plants need certain nutrients for successful growth and reproduction.

2. Have each student make a manure tea bag by placing two tablespoons of manure into a coffee filter and stapling it shut. Staple a string to one end and ½ of an index card to the other end of the string. Have students create and draw labels for their “brands” of tea on the index cards.

3. Hang the tea bags in a covered five-gallon bucket that is full of water. Let the bags steep overnight. Record observations.

4. Design and perform a class experiment that will determine the optimum manure tea concentration for growing corn. At the conclusion of the experiment, discuss how their newly-gained knowledge can relate to large-scale agriculture.
Plant Utilization – Phosphorus, one of the 17 chemical elements required for plant growth and reproduction, is often referred to as the “energizer” since it helps store and transfer energy during photosynthesis. It is also part of the genetic material of all cells—DNA and RNA.

All plants require phosphorus during all phases of growth. Most annual plants (plants that grow, reproduce, and die in one year) require large amounts of phosphorus as they begin to grow. Plants grown in cold weather which have limited roots and rapid top growth, such as lettuce, are high phosphorus users. Legumes also require plentiful amounts of phosphorus. Established plants such as trees, shrubs, and vines, especially those grown in warm climates with long summers, require the least amounts of phosphorus fertilizer.

Production – In the soil, phosphorus is often found in chemical forms that cannot immediately be absorbed by plants, so farmers commonly apply phosphorus to the soil. The common source for commercial phosphorus fertilizer is rock phosphate, a calcium phosphate ore found in deposits within the earth. Rock phosphate is usually strip mined and then pulverized. The resulting material is treated with sulfuric, phosphoric or nitric acid to produce various soluble phosphates that can be used as fertilizers such as monoammonium phosphates, diammonium phosphates, and super-phosphates.

Forms – All plants require phosphorus. Plants most often absorb phosphorus in the form of phosphate ions \( \text{H}_2\text{PO}_4^- \) and sometimes as \( \text{HPO}_4^{2-} \). These phosphate ions react readily with the soil and become part of the soil particles in a process called “fixation.” Fixation prevents the leaching of phosphorus, but also changes it to a form that plants cannot use. The challenge in agriculture is to provide plants with the proper amount of phosphorus, in the proper form, at a time when the roots will absorb it.

The phosphorus concentration in fertilizer is reported as \( \text{P}_2\text{O}_5 \) and is represented by the middle number of the three numbers listed on the label. Manufactured fertilizers come in both liquid and granular form. Organic fertilizers, such as manure, contain phosphorus in limited quantities. Growers usually apply phosphorus directly near the root zone. This is called banding and makes the phosphorus available for immediate absorption by the roots. Growers often mix phosphorus in soil when planting seedlings or transplanting trees, shrubs, or vines.

History – Early American farmers used ground bones as fertilizers, however, very little of the phosphorus in the bones was available to the plants. In 1808, Sir James Murray of Ireland produced the first effective phosphorus fertilizer. Murray treated bones with sulfuric acid, converting the phosphorus to phosphate, a form of phosphorus plants can absorb. Murray later discovered that rock phosphate could be used in this same process.

In 1851, John Jay Mapes of Long Island, New York, built the first phosphate manufacturing plant in the United States. Thus, he earned the title of “Father of the American Fertilizer Industry.” By 1889, America produced 90 percent of the world’s phosphate fertilizer and continues to produce 30 percent of the fertilizer produced today.

Top Producing Regions – In 2008, China led the world in phosphate production with 35 million tons, followed by the U.S. with 31 million tons, and Morocco/Tunisia with 28 million tons. The U.S. remains the leading exporter of phosphate fertilizers. In 2009, China led all countries in annual phosphate fertilizer consumption with 10 million metric tons followed by India which consumed more than five million tons and the U.S. with more than four million tons.

In 2007, Florida and North Carolina accounted for 85 percent of the total domestic output of phosphate rock. Production also occurs in Idaho and Utah. India and China are the major destinations for United States exports of phosphate fertilizers.

Economic Value – The economic value of the phosphate industry is difficult to assess. The fertilizer value alone is more than $3.5 billion, but the additional value associated with this industry for mining and food production greatly exceeds this value.

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### Lesson Ideas

- On a United States map, color the states yellow that mine rock phosphate.
- Learn about the physical and chemical properties of phosphorus.
- Research and list foods high in phosphorus and learn how phosphorus is used in the human body.
- Interview a nurseryman and ask when and how phosphorus should be applied to your favorite plants.
- On a world map, color the major phosphorus producers one color and the major phosphorus importers another.
- Research how phosphorus rock is processed into phosphate fertilizer.
- Invite farmers into your class to discuss how plant nutrients are added to their particular crops.
- Create a comic strip whose main character is “Phosphorus—the Energizer.”
- Discuss how a finite resource such as phosphorus can affect the world’s food supply.
- Explore how various manures are used as fertilizers.

### Fantastic Facts

1. In what part of their life do annual plants require the most phosphorus?
2. Where does most phosphorus come from?
3. Which country is the largest phosphate producer?
4. True or false? Plants that have small root systems and lots of above ground growth require plentiful amounts of phosphorus fertilizer.
5. Before rock phosphate, what was used to provide plants with phosphorus?
6. Which two states produce the most rock phosphate in America?
7. What is the symbol for the element phosphorus?
8. Which number of the three numbers on a fertilizer label represents phosphorus?

   1) At the beginning and in other periods of rapid growth  
   2) Rocks  
   3) China  
   4) True  
   5) Ground bones mixed with dilute sulfuric acid  
   6) Florida and North Carolina  
   7) P  
   8) The middle number

### Lesson Plan: Read the Label

**Introduction:** Fertilizer labels have a standard format and always list three main numbers. The first number represents the percentage of nitrogen (N) in the particular fertilizer. The second number represents the percentage of phosphorus (P₂O₅), and the third number represents the percentage of potassium (K₂O) in the fertilizer. Students will examine fertilizer labels, research the nutrient needs for a particular crop, and then create a fertilizer label specifically geared for that particular crop.

**Materials:** Fertilizer labels, white paper, markers, reference books.

**Procedure:**

1. Distribute sample fertilizer labels. In groups, have students examine the labels. As a class, create a template for a standard fertilizer package. Discuss what the three numbers mean on the front label.
2. Have each student select a crop for which they will find out its nutrient requirements. They may use encyclopedias, the Internet, a local agricultural commissioner’s office, or information from the University of California Cooperative Extension.
3. Have students create fertilizer labels for their specific crops.
4. As a class, compare the fertilizer labels the students developed. Could one fertilizer be used for more than one commodity? Discuss what other factors might be considered when determining what fertilizer to purchase—price per unit, package size, soil type, climate, availability of composts and manures.
5. Invite an agronomist or fertilizer manufacturing representative to your class to discuss the uses and sales of fertilizers.
Plant Utilization – Potassium, one of the 17 chemical elements required for plant growth and reproduction, is often referred to as the “the regulator” since it is involved with more than 60 different enzyme systems in plants. Potassium helps plants to resist drought and effects from excessive temperatures. It also increases crop resistance to disease. Potassium aids plants in the production of starches, controls root growth, and regulates the opening and closing of pores in plant cells (called stomata), which is important for efficient water use.

All plants require potassium, especially crops high in carbohydrates, like potatoes. Studies have shown that adequate amounts of potassium may promote the growth of long, strong cotton fibers; increase the shelf life of fruits; increase the stem length and quantity of roses; enhance the green color and growth of turf grass; and increase the size and quality of fruits, grains, and vegetables.

Production – Potassium is the seventh most abundant element in the Earth’s crust, yet only one to two percent is available to plants. The rest is incorporated in the structure of the rocks and unavailable to plants. Farmers often apply potassium fertilizer for optimum plant growth. Most potassium is mined from underground deposits and is shaft mined, like coal. Some shafts are drilled as deep as 3,000 feet. In some cases, solution mining is also used in which case water is pumped into the shaft to dissolve the ore. The solution is extracted and allowed to evaporate, leaving behind potassium salts. Some potassium comes from the evaporation of water from natural salt lakes, such as the Great Salt Lake in Utah, and the Dead Sea in Israel and Jordan. Tobacco stems, wood ash, wool waste, sugar beet factory waste and flue dust also contain potassium, but their use as a fertilizer is limited.

Forms – Potassium is symbolized as K₂O on fertilizer labels and is the third number on the label. Plants absorb potassium in the form of the ion K⁺ which dissolves readily in water. Ninety-five percent of all potassium fertilizers come in the form of muriate of potash, also known as potassium chloride. For crops unable to tolerate chloride, potassium sulfate, potassium nitrate and other chloride-free salts are used. Potassium comes in both liquid and granular form and is usually mixed in the soil or placed directly near the root zones of plants. Application of chloride-free foliar sprays are sometimes used on certain crops.

History – The letter K, used to symbolize potassium, comes from the German word Kalium. Before the industrial era, people burned wood and other organic matter in pots to manufacture soap. The ashes were rinsed and the water was allowed to evaporate, leaving a residue of potassium salts. People called the residue “pot ashes” or potash. These salts were boiled with animal fat to produce soap.

In 1868, Samuel William Jackson, a botanist in Connecticut, burned plants and analyzed the ash. Jackson found plants consisted of large amounts of potassium, and other minerals. His work led to the use of fertilizers to promote an increase in crop yields. The very first US patent issued by the United States government was for an improved method of potash production.

Top Producing Regions – Canada leads the world potash fertilizer production and exports, producing nearly 8 million tons in 2009. Russia, Belarus and Germany are also top producers of potash. U.S. production has been stable with most domestic production occurring in New Mexico. Lesser amounts are produced in Utah and Michigan. The price of potash fertilizer has increased significantly in the past few years, causing mining companies to seek new sources of the raw material throughout the world.

China is the world’s leading potash consumer, using 8 million tons in 2009. The U.S. and India are the next leading consumers of potash. Approximately 20 percent of the 6.5 million tons of potash used in the U.S. is domestically produced.

Economic Value – United States farmers pay $900 million annually for potassium fertilizers, with California farmers paying, approximately $30 million each year.

For additional information:
California Fertilizer Foundation
4460 Duckhorn Drive, Suite A
Sacramento, CA 95834
(916) 574-9744
Fax: (916) 574-9484
Email: maryj@healthyplants.org
Website: www.calfertilizer.org
Potassium Activity Sheet

How Potassium Functions in Plants

- Helps retard crop diseases.
- Builds cellulose needed for stalk and stem strength.
- Aids in photosynthesis and food function.
- Increases root growth and improves drought resistance.
- Produces grain rich in starch.
- Necessary for plant protein formation.
- Reduces water loss and wilting.
- Assists many enzyme actions.

Lesson Ideas

- On a world map, color the major potassium exporters blue and the major importers red.
- On a map of North America, locate and color the areas where potassium is mined.
- Research how humans utilize potassium and find out what foods are high in potassium.
- Make a poster illustrating the various roles potassium plays in plant growth and health.
- Locate potassium on the periodic table of elements. Learn about its physical and chemical properties.
- Find two points that are 3,000 feet apart so students can appreciate the depth of some potassium mine shafts.
- Research the Colonial soap-making process and the various uses of potash.
- Find out how agronomists determine the potassium contents of soils.

Fantastic Facts

1. What country is the world’s leading exporter of potassium?
2. How is most potassium obtained?
3. Why is potassium sometimes called “the regulator?”
4. Name two ways potassium helps plants.
5. Which state in the United States processes the most potassium?
6. Why is potassium called “potash?”
7. Is California a larger importer or exporter of potassium?
8. Name a large United States lake from which potassium is obtained.

1) Canada 2) Through underground mining 3) It regulates or controls many plant enzyme systems 4) It aides in protein and starch formation, stimulates root growth, provides winter hardiness, and opens and closes cell pores called stomata 5) New Mexico 6) Potash used to come from pot ashes, residue found in wood ashes 7) Importer 8) The Great Salt Lake in Utah

Lesson Plan: The World of Potassium

Introduction: Potassium is an essential nutrient for plants and animals. It also has many other uses, depending on its chemical formulation. Your students will research potassium and its various uses in detail and create a wall-length mural, which depicts its importance.

Materials: Reference materials, including encyclopedias, human nutrition books, plant nutrient requirement books, butcher paper, paint or markers, glue.

Procedure:
1. Write the following phrases on index cards: plants which produce fibers for clothing; annual crops, such as celery; forage crops, such as alfalfa; tubers, such as potatoes; disinfectant; human nutrition; component in soap; plant guard cells; potassium forms which are usable by plants; agricultural by-products which contain potassium; roses and other flowers.
2. Divide the students into groups of three or four and distribute one index card to each group.
3. Each group is responsible for researching how potassium relates to the key words on the index card. After they gather the details, the group is to decide how they will depict their knowledge on a wall mural called “The World of Potassium.”
4. In a class discussion, determine what the class mural will look like so that all aspects of potassium use will be displayed.
5. Have each group create their graphics and text for the mural and then place it on the mural.
6. Display the mural at a science night or in the library. This may be displayed with other murals made for other elements, such as nitrogen and phosphorus.
Food Safety from Farm to Fork
An Interdisciplinary Educational Unit for Grades 5-7
Americans enjoy the safest food supply in the world, yet the most common intestinal ailments in the United States are caused by foodborne illnesses. How can this be?

**Food Handling Is The Key!**

This unit provides fifth through seventh graders a better understanding of food safety through real-life examples and enjoyable activities. They learn that everyone has a responsibility in minimizing foodborne illnesses—farmers, transporters, restaurants, grocery stores... and the consumer! Through reading, games, puzzles, math problems and science investigations, participants identify the roles each one of us plays to ensure the food we enjoy is safe to eat.

Food gathering and preparation have changed over time. Americans have gone from growing and preparing their own food to enjoying convenience foods grown by a fewer number of farmers and prepared by someone other than themselves. Thus food safety practices are important in every stage of food production, preparation, and consumption. Here are a few examples of food safety practices from each area.

**The Farm**

Good Agricultural Practices have been developed jointly by the agricultural industry and government. These provide guidelines that reinforce already stringent laws governing food safety on U.S. farms.

**The Food Handlers**

Grocery stores, transportation companies, storage facilities and restaurants have food safety rules and require employees to abide by them. Stringent regulations imposed by national, state and local governments, based on sound science, ultimately benefit the consumer.

**The Consumer**

This educational guide is part of a consumer food safety education program. The consumer, the person who eats the food, is responsible for making sure that the food is prepared and stored properly. This is crucial since most foodborne illness outbreaks are associated with improper handling at the restaurant or home.

So take a look through the guide. See how you can use it to teach your students about foodborne illnesses and reduce the number of foodborne illness incidents. At the same time your class will practice reading and writing, investigate and experiment, apply math to real situations, and practice thinking critically about a topic that impacts all of us daily—food safety!

**Nutrition!**

Throughout the lessons, discuss the importance of eating right. The human body has natural defense mechanisms that work best when we eat right, get plenty of exercise, drink lots of water and get enough sleep!

**Links to Content Standards for California Public Schools**

Students learn and retain information best when they can relate what they learn in the classroom to their personal lives. This multidisciplinary, thematic unit on food safety includes lessons that teach or reinforce many educational Content Standards for California Public Schools. Each activity includes a listing of the specific content standards addressed. Refer to the California Department of Education Website (www.cde.ca.gov) for descriptions of the educational standards.

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- Why Teach About Food Safety? ................................. 2
- Playing It Safe .................................................. 3
- Operation Kitchen Impossible ................................. 7
- Mighty Microbes: Who Done It? ............................... 9
- So How Fast Will They Grow? ............................... 12
- How Safe Is Your Kitchen? .................................... 14
- Other Activities, Resources, Literature and Websites ........ 15

**Did you know? It is common to find bacteria on produce, but this bacteria is not harmful to people.**

**A small percentage of foodborne illness outbreaks can be traced back to the growing, packing, shipping, or processing of fruits and vegetables.**
**Description**

Students will learn the basic science of food safety and the importance of safe food practices while playing a board game, performing “fact or opinion” and “cause and effect” activities, and then writing an essay on what they learned.

**Activity**

1. Explain that students will learn about the science of food safety.
2. Discuss the differences between “facts” and “opinions.” Select students to read dictionary definitions of these two terms.
3. Have students number a piece of paper from 1-6. Instruct them to listen to the statements that you read to them. They are to write an “F” next to the number if they think the statement is a fact, and an “O” if the statement is an opinion. Read the statements below, one at a time, and have the students record their answers. Discuss the answers.

**Fact or Opinion?**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
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<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. In preparation for the game, orally read *What’s All the Talk About Food Safety?*
5. Create groups of three to four students. Explain *Playing it Safe* and then have the students play the game.

**Directions:**

a. Shuffle the playing cards and place them face down on the board.

b. Place the sponge markers on “Start.”

c. The first player draws a card from the top of the stack, reads it aloud, and then moves the number of spaces directed. All students should listen to the fact stated on the card, making a mental note that the statement is indeed a “fact.” If a person must move “back” but is already on “Start,” then the player should remain on “Start.”

d. The next player takes a turn. Continue until one player crosses the finish line. Reuse the cards, if necessary.

6. Remind students that a “cause” is something that makes something else happen. What happens is the “effect.” Have groups do the Cause and Effect activity located on the game board. Students should agree on the answers and discuss as a class.

7. Have each student write a three paragraph essay that covers the following information. Once written, have students edit for proper grammar, spelling, and punctuation, including capitalization.

   a. What is food safety and why is it important to use safe food practices?

   b. Define “foodborne illness” and provide specific examples of foodborne illnesses.

   c. Describe several things a person could do to prevent foodborne illnesses.

**Content Standards for California Public Schools Links**

**English Language Arts**

**Grade 5**

Reading 2.5
Writing 1.0, 1.2

Written and Oral English Language Conventions 1.0, 1.4

**Grade 6**

Reading 2.2
Writing 1.0, 1.2

Written and Oral English Language Conventions 1.0, 1.4

**Grade 7**

Reading 2.3
Writing 1.0, 1.2

Written and Oral English Language Conventions 1.0, 1.6

**Health Education**

**Grade 5**

Nutrition and Physical Activity 1.5.N

**Grade 7**

Nutrition and Physical Activity 1.3.N, 1.4.N

**Cause & Effect Activity Answer Key**

<table>
<thead>
<tr>
<th>No.</th>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>not refrigerated</td>
<td>turned sour</td>
</tr>
<tr>
<td>2</td>
<td>washed hands</td>
<td>healthful salad</td>
</tr>
<tr>
<td>3</td>
<td>warm summer</td>
<td>more foodborne illnesses</td>
</tr>
<tr>
<td></td>
<td>temperatures</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>added rennet</td>
<td>made cheese</td>
</tr>
<tr>
<td></td>
<td>(bacteria)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>core in bin</td>
<td>decomposed to compost</td>
</tr>
</tbody>
</table>
What’s All the Talk About Food Safety?

Did you ever have an upset stomach or something that people call the 24-hour flu? If your symptoms lasted less than a day, chances are your brief illness was caused by a foodborne illness. You will learn about ways you can minimize the number of foodborne incidents you have in your lifetime.

What is a foodborne Illness?

A foodborne illness is a disease that is carried to animals or humans by food. Foodborne illnesses are caused by microorganisms such as bacteria. Not all bacteria cause disease in humans. Those that do are called pathogens. They grow rapidly when conditions are right—dark, damp places where temperatures range between 40°F and 140°F. Any type of food can be a source of a foodborne illness; however, high protein foods are responsible for most of them. Examples include milk and milk products, eggs, meats, poultry, fish, seafood, and soy protein food such as tofu.

What is food safety?

Food safety is the practice of making sure that people have the healthful food they need for an active, healthy lifestyle. Some foods, particularly fresh fruits and vegetables, are not cooked before we eat them. These foods must be handled correctly to make sure they are safe to eat. The Centers for Disease Control reports the majority of foodborne illnesses associated with fresh fruits and vegetables are due to improper food handling at the foodservice or consumer level. They are contaminated with pathogens and then not cooked or stored properly. Since you handle food, you can do your part to keep your food safe.

Who is responsible?

All people have a personal responsibility to keep food safe. Farmers are the first people responsible for producing healthful food. They must know how to plant, cultivate, irrigate, harvest, and store the food so that the final product is safe for the consumer. Farmers are responsible for making sure that the people involved in their operations follow the guidelines established by the United States Department of Agriculture (USDA). In the 1990s, the agricultural industry adopted some guidelines called GAPs—Good Agricultural Practices—that keep food safe at the farm level.

People who pack, process and transport food must make sure that food is kept at proper temperatures, and handled and washed appropriately. Storage facilities must be kept clean. Grocers and those who prepare and serve food at restaurants are responsible for using proper food safety procedures. You, the at-home consumer, must do your part too! It requires teamwork.

Beneficial Microbes

Microbes live almost everywhere! In fact, you are covered with microbes inside and out! Your mouth contains more than 600 kinds! Your large intestine contains Escherichia coli, a bacterium. Lactobacillus acidophilus turns milk into yogurt. Saccharomyces cerevisae, also known as yeast, makes bread rise. Bacillus thuringiensis (Bt), a natural pesticide, is found in the soil and is used by farmers and home gardeners. Rhizobia are bacteria that live in the nodules of some plant roots, such as beans and alfalfa, and convert nitrogen into a form plants can use. Without microbes to decompose things, the world would be covered with waste. In fact, Earth as we know it would not exist!

Bacteria Out of Control!

Under certain conditions, a bacterium can double in population every 10 to 30 minutes—usually in warm, damp and dark places. People can get sick when they eat foods that have been contaminated by harmful bacteria. Salmonella and E. Coli are common bacteria that cause foodborne illnesses. Seems funny that one form of E. Coli is inside our gut, but if we eat another form, it can make us sick. That’s strange but true!

Since pathogens can live almost anywhere, it is important to clean, separate, chill, and cook your food properly… and then eat it in a timely manner.
Cause and Effect

Read each of the following statements. Underline the “cause” and circle the “effect.”

1. The milk was not refrigerated, so it turned sour.
2. Miguel washed his hands before making a tasty, healthful salad.
3. There are more foodborne illnesses in the summer because bacteria multiply quicker in warmer temperatures.
4. Grandma made cheese after adding rennet to milk.
5. Sandra threw her apple core into the outdoor bin so it would decompose and become compost.
<table>
<thead>
<tr>
<th>You washed your hands for 20 seconds with warm water and soap before helping make dinner.</th>
<th>You pet your dog and let him lick your hand. Then you helped mom cut up lettuce for the salad without washing your hands.</th>
<th>You used a clean paper towel to wipe off the kitchen counter and then disposed of it properly.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
<td><strong>GO BACK 2 SPACES.</strong></td>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
</tr>
<tr>
<td>You cooked your scrambled egg until all of it was firm.</td>
<td>You washed your cutting board under hot soapy water after cutting the eggs, but before you started slicing the potatoes for the salad.</td>
<td>You were tired, so you left the potato salad on the counter for 2 hours before putting it away.</td>
</tr>
<tr>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
<td><strong>MOVE BACK 2 SPACES.</strong></td>
</tr>
<tr>
<td>When your dad barbecued, you washed the raw meat juices off the platter with warm soapy water before he put the cooked meat back on it.</td>
<td>You washed the plastic cutting board in the dishwasher after dinner.</td>
<td>You washed your hands but a towel was not close by. You wiped them on the legs of your pants.</td>
</tr>
<tr>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
<td><strong>MOVE AHEAD 4 SPACES.</strong></td>
<td><strong>MOVE FORWARD 2 SPACES, THEN BACK 2 SPACES.</strong></td>
</tr>
<tr>
<td>You cut up the chicken for fajitas with a sharp knife and then cut your veggies without rinsing the knife or cutting board.</td>
<td>Before talking on the phone, you helped your mom put the leftovers in the refrigerator as soon as dinner was over.</td>
<td>You put your dish sponge in the microwave on high for one minute before you wiped off the counter.</td>
</tr>
<tr>
<td><strong>MOVE BACK 4 SPACES.</strong></td>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
</tr>
<tr>
<td>You asked the bag clerk at the supermarket to put the chicken in a separate bag from your fruits and vegetables.</td>
<td>You cut up cheese slices but didn't clean the cutting board when you finished.</td>
<td>You let the kitchen sponge soak in the dishwasher overnight. In the morning you wiped down the counter with it.</td>
</tr>
<tr>
<td><strong>MOVE AHEAD 4 SPACES.</strong></td>
<td><strong>MOVE BACK 2 SPACES.</strong></td>
<td><strong>MOVE BACK 3 SPACES.</strong></td>
</tr>
<tr>
<td>Mom called and asked you to put the ground beef out to thaw. You placed it on the counter top all day to defrost.</td>
<td>As your chicken defrosted in the refrigerator, the juices dripped onto the refrigerator shelf. An apple rolled into the juices.</td>
<td>Your steak was barely warm and looked under-cooked when you went out to dinner with your friends. You didn’t want to say anything, so you ate it anyway.</td>
</tr>
<tr>
<td><strong>MOVE BACK 3 SPACES.</strong></td>
<td><strong>MOVE BACK 3 SPACES.</strong></td>
<td><strong>MOVE BACK 2 SPACES.</strong></td>
</tr>
<tr>
<td>You dried the dinner dishes with the cloth that had been hanging all week on the refrigerator door.</td>
<td>You remembered to tie back your hair while you were making a cake for your brother's birthday.</td>
<td>You understand the importance of keeping hot foods hot and cold foods cold, and not cross-contaminating raw food with cooked food.</td>
</tr>
<tr>
<td><strong>MOVE BACK 3 SPACES.</strong></td>
<td><strong>MOVE AHEAD 3 SPACES.</strong></td>
<td><strong>MOVE AHEAD 4 SPACES.</strong></td>
</tr>
</tbody>
</table>

**Instructions:** Copy and cut one set of game cards for each group.
OPERATION
KITCHEN IMPOSSIBLE

Description
In this lesson, students become the head chef in a virtual kitchen. They will use mathematical knowledge, problem-solving skills and food safety guidelines to prepare a safe and nutritious meal.

Activity

Part 1: Introducing Food Safety
1. Brain Dump! Ask students, “What can we do to keep food safe?” Give students 30 seconds to capture their ideas on a personal sheet of paper. Capture thoughts on a common share sheet.
2. Instruct one student to read Chef Al's recipe card (pg. 8) out loud.
3. Divide students into four collaborative working groups. Assign each group one of the four safety tips below. Each group is to develop and present a 30-second song, rap, or poem sharing important information about their safety tip. Divide a large class into eight groups and feature each tip twice.
4. After each presentation, have the class identify an anchoring movement to recall the important concept presented. For example, students may make a motion with their hand like they are opening the refrigerator door to represent the First In, First Out (FIFO) principle.

Part 2: Applying What We Know
1. Lead students in a review of safety tips and anchoring movements.
2. Have students work individually or with a learning partner to complete the scenario-based problems on the Operation Kitchen Impossible handout (page 8). Students should use a separate sheet of paper to solve problems and record answers.
3. Don’t forget it! Have one student read problem 10 of the handout about farmers and ranchers’ commitment to food safety. Challenge each student to share with the class one personal commitment to food safety.

Safety Tips

Buy it Cold—Keep it Cold!
Take food straight to the fridge after buying. Choose packages tightly wrapped without tears or holes. Freeze fresh meat if you can’t use it within two days. Defrost meat in the refrigerator or using the microwave—don’t leave it out!

Heat it Up Before You Eat it Up!
Foods must reach a certain temperature to be considered safe. Keep these in mind: poultry 165°F, ground beef 160°, beef roasts and steaks 145°, pork 160°, leftovers 165°.

FIFO!
When storing meat, label each package with the date and item. Practice the FIFO system, First In (the fridge), First Out!

Separate—Don’t Cross-Contaminate!
Keep raw meat, poultry and seafood away from other foods to prevent the spread of bacteria. Use separate cutting boards for meat and other foods. Always wash your hands and food preparation areas with soap and water before and after use.

Answer Key
1) a. ¼ hour; b. 1½ hours; c. ¾ hour
2) 20°
3) 159°
4) 142.5 pounds beef
5) 25.5 gallons milk
6) 6 bags
7) x = 2 cups
8) 48 ft.²
9) 6 oz. solution
10) Answers will vary by student.

Time
Part 1: 60 minutes
Part 2: 30-45 minutes

Materials
For class as a whole:
• Share sheet
• Markers
• Safety tips, cut out (4)
For each student:
• Operation Kitchen Impossible handout
• Personal sheet of paper
• Pencil
• Calculator (if desired)

Content Standards for California Public Schools Links

Mathematics
Grade 5
Number Sense 1.2, 2.2, 2.4, 2.5
Algebra and Functions 1.1, 1.2
Statistics, Data Analysis, and Probability 1.1

Grade 6
Number Sense 1.3, 2.1
Algebra and Functions 1.1, 2.2, 2.3
Statistics, Data Analysis, and Probability 1.1

Grade 7
Number Sense 1.2, 1.3
Algebra and Functions 1.2, 1.4, 1.5
Measurement and Geometry 1.1, 2.1

Health Education
Grade 5
Nutrition and Physical Activity 1.5.N
Personal and Community Health 1.1.P

Grade 7
Nutrition and Physical Activity 1.3.N, 1.4.N, 7.2.N

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Warming up!

1. Cooking food for the appropriate length of time is important in food safety! Chef Al left these times in code, by writing them as decimals. Convert the following cooking times from decimals to fractions.
   A) 0.25 hours  
   B) 1.5 hours  
   C) 0.75 hours

Use the graph on the right to answer questions 2 and 3.

2. What is the difference in recommended internal temperature between poultry and beef steaks?

3. What is the average internal temperature for all foods listed?

Now you’re cooking!

4. Chef Al warned you not to leave too much food out or it will spoil. He uses 95 lbs. of beef for 200 people, but tonight you are expecting 300 people. How many pounds of beef should you put in the fridge to thaw?

5. Dairy products need to be refrigerated so they don’t go bad. Calculate how many gallons of milk you will need to make Chef Al’s famous Alfredo sauce. He uses 17 gallons to serve 200 people, but you are expecting 300.

6. You pull out frozen pizza dough from the freezer that Chef Al has carefully labeled with the contents, date and amount of dough. You need 15 lbs. of dough to thaw for dinner. If each bag weighs 2½ lbs. how many bags do you need to take out of the freezer?

On fire!

7. Chef Al left his pasta recipe in a secret code. For the amount of flour, Chef Al wrote 2(3x+4) = 20. Solve for the variable to determine how many cups of flour are needed.

8. Make sure you don’t cross-contaminate! You must clean the counter in the kitchen before you begin preparing food. The counter is 4 ft. wide and 12 ft. long. What is the area of the counter?

9. The antibacterial cleaning bottle says that you need ½ ounce of solution for every 4 square feet of surface area. Using your answer from problem 8, how many ounces of antibacterial solution do you need to make sure your counter is clean?

10. American farmers and ranchers are committed to continued research in the area of food safety. What is your food safety commitment? Take a moment to write down three specific actions you will take to commit to food safety in your home.
Mighty Microbes

Who Done It?

Description

Students, acting as epidemiologists, look at the facts of an outbreak and determine the source and cause of an illness that makes many picnickers sick. Interpreting data tables, classifying, and reading are incorporated into this investigative epidemiological mystery.

Activity

1. Explain to the students that they will become epidemiologists and determine the cause of an illness that affected many people in a community. Have someone read the dictionary definition for “epidemiology” and discuss its meaning. Also, discuss that actual epidemiology cases are much more complex than the hypothetical case they are about to analyze.

2. As a class read the foodborne illness outbreak scenario on page 10.

3. Discuss the terms “outbreak” and “dichotomous,” as well as any others the students may find difficult. Create a class vocabulary list if necessary.

Have student duos complete the activity as described on the student worksheet.

NOTE: Have newspaper articles handy for students to use as a guideline for writing their news article as described on page 10.

ANSWER KEY

The unhealthy microbes in the fruit juice were most likely transmitted by an ill worker who had a foodborne illness himself. His improper handling of the cups and juice, along with warm temperatures, spread the disease to the juice. The dichotomous path used to reach this conclusion is: 1a, 2a, 3a, 4a, 5a.

Local Health Department

Conducting Investigation!

Time

Two 50-minute sessions

Materials

For each student:

• What Caused the Illness? student page
• What Caused the Foodborne Illness? Dichotomous Key
• Samples of newspaper articles

Content Standards for California Public Schools

English Language Arts

Grade 5

Reading 1.0, 2.0, 2.1, 2.1, 2.2
Writing 1.0, 1.2, 1.3
Written and Oral English Language Conventions 1.0, 1.4

Grade 6

Reading 2.0, 2.1, 2.1, 2.2, 2.5
Writing 1.0, 1.1, 1.2, 2.2
Written and Oral English Language Conventions 1.0, 1.4

Grade 7

Reading 2.0, 2.3
Writing 1.0, 1.1, 1.2
Written and Oral English Language Conventions 1.0, 1.4

Science

Grade 5

Investigation and Experimentation 6, 6a, 6i

Grade 7

Investigation and Experimentation 7, 7c, 7e

Health Education

Grade 5

Nutrition and Physical Activity 1.5.N

Grade 7

Nutrition and Physical Activity 1.3.N, 1.4.N
What Caused the Illness?

Name ______________________________

Scenario

The local hospital has treated numerous people for dehydration due to uncontrollable vomiting followed by diarrhea. The county health department is conducting an investigation to determine the causative agent. It was determined that all the patients ate at a community get-together on May 16 and that the illnesses were caused by a foodborne pathogen, a disease-causing microorganism obtained from something the people ate or drank. Look at the data chart above. Each of the 20 people in the chart were hospitalized. Determine what food was responsible for the food poisoning.

PATIENT DATA CHART:

<table>
<thead>
<tr>
<th>Patient</th>
<th>Hot Chocolate</th>
<th>Fruit Juice</th>
<th>Bottled Water</th>
<th>Granola Bar</th>
<th>Popcorn</th>
<th>Cut Vegetables</th>
<th>Veggie Dip</th>
<th>Watermelon</th>
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</tbody>
</table>

+ = that person ate item  - = that person did not eat item

1. From the data above, what food do you suspect caused the illness?

2. In one complete sentence, describe your reasoning.

3. Discuss your reasoning with the lead epidemiologist (your teacher) and then obtain the dichotomous key to continue your investigation.

4. Using the dichotomous key, determine the actual source of the illness. Complete the following statement. “Through scientific investigation, my team has determined that the people at the get-together on May 16 became ill because:

5. Suppose you are a reporter for the local newspaper. Write a three to five paragraph article that describes what happened, why it happened, and how the foodborne illness could have been avoided. Before writing your story, examine a newspaper article to see how it is set up. Make sure your article has:

• a headline
• authors listed
• facts of what happened
• facts about foodborne illnesses in general
• how this incidence could have been avoided

• quotes from experts or witnesses (pretend you interviewed patients, event planners, food handlers, epidemiologists, etc.)
• been proofed for spelling, capitalization, proper punctuation, sentence structure, and flow of story
**What Caused the Foodborne Illness? Dichotomous Key**

**Instructions:** Read number 1. Determine which statement, a or b, best reflects the incident and information. Proceed as directed, until the illness is traced back to its source. This is called a “trace-back,” something that epidemiologists do on a regular basis.

1. The fruit juice was made from frozen fruit juice concentrate, which was pasteurized at the plant. Pasteurization is when something is heated to a temperature high enough to kill microorganisms. The can had a batch number of 10394-PR on its end. A bacterial count was determined from a frozen concentrate with the same batch number. Look at the chart above.
   - **a.** If the bacterial count was 0 in 3 milliliters of juice, the illness was not likely caused by the concentrate itself. Go to 2.
   - **b.** If the bacterial count was 1 per 3 milliliters of juice or greater, the illness was likely caused by the bacteria in the concentrate before preparation. Illness came from fruit juice concentrate.

2. Water used to dilute the juice concentrate came from the tap and is tested by the city’s Public Works Department on a regular basis. Here are the data for a 3-week period.
   - **a.** If the bacterial level of the water was 0 or less, the water was not the cause. Go to 3.
   - **b.** If the bacterial level of the water was 1 or higher, bacteria from the water could be the culprit.

<table>
<thead>
<tr>
<th>Test Performed</th>
<th>May 10</th>
<th>May 17</th>
<th>May 24</th>
<th>Max. Allowable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial Count</td>
<td>None detected</td>
<td>None detected</td>
<td>None detected</td>
<td>None detected</td>
</tr>
<tr>
<td>Copper (ppm)**</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>170</td>
</tr>
<tr>
<td>Nitrates (mg/l)*</td>
<td>22</td>
<td>19</td>
<td>21</td>
<td>45</td>
</tr>
<tr>
<td>Calcium (ppm)**</td>
<td>48.2</td>
<td>41.7</td>
<td>48.1</td>
<td>300</td>
</tr>
<tr>
<td>Lead (ppb)***</td>
<td>None detected</td>
<td>None detected</td>
<td>None detected</td>
<td>None detected</td>
</tr>
<tr>
<td>Fluoride (ppb)***</td>
<td>110</td>
<td>98</td>
<td>110</td>
<td>2000</td>
</tr>
</tbody>
</table>

* mg/l = milligrams per liter ** ppm = parts per million *** ppb = parts per billion

3. Ice was added to the juice. The ice came from ice cubes made of city water and were made fresh with clean ice cube trays.
   - **a.** The ice was probably not the source of illness. Go to 4.
   - **b.** The ice could have been the problem.

4. The prepared juice was at the park for the entire event on May 16 from 2 p.m. until 5 p.m. Use the following information gathered from the event manager to make an appropriate choice.

The juice was prepared at noon on May 16th in insulated jugs that each hold 5 gallons. The juice concentrate was frozen at the time it was made and was mixed with tap water. The coordinator made the volunteers wash their hands before making the juice. A few ice cubes were put into the insulated container, which the volunteers rinsed out with hot, soapy water prior to using. It was stored at room temperature until 1 p.m. at which time it was taken outside to the picnic tables. At the event, juice was removed from the container through the push button spout and placed into paper cups. The filled cups were on the table throughout the event. When necessary, new paper cups were filled with juice. The coordinator said that less people attended the event than expected but that everyone had a great time. The event ended at 5 p.m.

   - **a.** The juice seemed to be prepared following food safety procedures. Go to 5.
   - **b.** The juice was not prepared following basic food safety procedures. Go to 6.

5. A quick survey of the overall health of the workers indicated that one of the workers at the fruit juice station had a severe stomachache and was feverish the night before the event.
   - **a.** A sick worker could have spread a foodborne illness to the guests at the event.
   - **b.** A sick worker could not have spread a foodborne illness to the guests. Go to 6.

6. Most bacteria grow best between the temperatures of 40°F and 140°F. View the chart below and the description in 4 and determine whether the outside temperature could have aided in bacterial contamination.
   - **a.** Outdoor temperatures could have caused contamination.
   - **b.** Most likely outdoor temperatures did not contribute to the illness. Go to 7.

7. How the juice was dispensed or stored could be the problem.
   - **a.** The juice could have sat in the cup for longer than two hours, as much time as it takes for harmful bacteria to reach a population that could cause illness. Juice that was not kept cool enough was most likely the problem.
   - **b.** The illness was caused by something other than handling. Further investigation needs to occur before a probable cause can be determined at this time.
SO...
How Fast Will They Grow?

Description
Students, acting as scientists, will explore bacteria and fungi. They will design an experiment that will promote or minimize the bacterial and fungal growth on a piece of white bread.

Activity
1. Prior to this activity, students should understand what bacteria are and that most are beneficial. Those which cause illness are called pathogens. Review if necessary.
2. Show the students the supplies for an experiment they will design. The goal is to either promote or minimize bacterial/fungal growth on a piece of white bread over a two-week period.
3. Have the students design and complete their experiments, record observations every other day and, after two weeks, write a formal lab report using the guidelines provided.
4. Discuss what is needed for bacteria to grow and what might minimize their growth. Relate this to food preservation and safety.
5. Divide students into teams of three. Assign each group one method of food preservation — drying, freezing, canning, fermenting, smoking, salting, pasteurizing. Using books and on-line sources, they are to:
   • Research their assigned form of food preservation
   • Learn about its history
   • Create a list of examples
   • Find out how it is done today
   • Create a poster with pictures and words that describes their food preservation process.

Time
One 30-minute session
10 minutes alternate days, two weeks
Three 50-minute sessions

Materials
• White bread without preservatives, two pieces per team
• Re-sealable plastic bags
• Thermometer
• Dark closet or shoebox with lid
• Hand lenses or microscopes
• Water
• Eye droppers
• Refrigerator access

Safety Note:
The plastic bags which contain bread must be kept sealed and disposed of properly. Do not allow students to open the bags under any circumstances! Harmful microorganisms could be in the bag.

Content Standards for California Public Schools Links

English Language Arts
Grade 5
Reading 2.0, 2.1
Writing 1.3, 1.4
Listening and Speaking 1.0, 1.5, 2.0, 2.2

Grade 6
Reading 2.0, 2.2
Writing 1.4
Listening and Speaking 1.0, 1.4, 1.6, 2.2

Grade 7
Reading 2.0, 2.1, 2.2
Listening and Speaking 2.0, 2.3a, 2.3b, 2.3c

Science
Grade 5
Investigation and Experimentation 6, 6b, 6c, 6h

Grade 6
Ecology 5
Investigation and Experimentation 7, 7a, 7b, 7d, 7h

Grade 7
Investigation and Experimentation 7, 7a, 7c, 7e

Health Education
Grade 5
Nutrition and Physical Activity 1.5.N

Grade 7
Nutrition and Physical Activity 1.3.N, 1.4.N
Introduction

Bacteria and fungi are all around us. They are responsible for many things. Most importantly, they decompose dead plants and animals and convert them into soil and nutrients that other living things can use. They are a part of all ecosystems. Some bacteria and fungi, however, can be harmful. These are called pathogens. It is important for people to understand how to minimize the amount of pathogens so that the food they eat can be nutritious and safe.

You and your partner are to design an experiment that will encourage or discourage bacteria and fungi from growing on a piece of bread. Before you place it in the plastic bag, you may expose it to a doorknob, backpack, notebook, or even moisture or heat. Or, you may expose it to nothing other than the container it was in. You decide! Design your experiment, have your teacher approve your procedure, and then perform your experiment.

Think About It!

Do bacteria and fungi prefer light or dark places?
What about moisture?
What about heat?

SAFETY NOTE:

Once you place your bread in the plastic bag and seal it, you may not open it under any circumstances. Some bacteria and fungi can be harmful. When finished with the experiment, give your bread, still in the sealed bag, to your teacher for proper disposal. You don’t want to get a disease from a pathogen!
Description

Restaurants and school kitchens are inspected each year by state health inspectors. They check to make sure that safe food preparation guidelines are in practice. Inspectors check equipment, storage facilities, and preparation areas. Food safety should also be practiced at home. Choose a meal. Evaluate your kitchen during its preparation and clean-up by using the form below. Discuss your findings with your family.

Kitchen Inspection Evaluation

Inspector: (your name) ________________________________
Date: _____________________ Time ___________________
Meal Inspected (circle one): Breakfast  Lunch  Dinner  Snack

Clean

Food preparer washed hands with warm, soapy water before handling food. Yes  No
Counter tops were cleaned before use. Yes  No
Cutting board was cleaned after preparing each food item and before going on to the next food item.

Separate to Prevent Contamination

Raw meat, seafood, poultry and other foods were kept separate from each other in the refrigerator. Yes  No
A separate cutting board was used for meat or the cutting board was washed before a different food item was prepared on it.

Knives and cooking utensils were washed immediately after they came in contact with raw meat or eggs. Yes  No
Cooked meat was placed on a clean dish. Yes  No
Raw egg shells were thrown away and any areas where raw eggs were used were washed with soapy water. Yes  No

Cook to Proper Temperatures

Meat was cooked completely, and hot food was completely heated. Yes  No

Chill: Refrigerate Promptly

Leftover food was placed in the refrigerator within two hours of preparation. Yes  No
Food meant to be cold was served cold. Yes  No

Total number of “Yes” answers: ___ X 10 = ______
Total number of “No” answers: ___ X 0 = ______
Total Score: ________________________________

If your score was:

90-110: You are “A” safe cook
70-89: You need to “B” a little more aware of food safety procedures.
50-69: You need to “C” the food safety rules and use them!
below 50: Sorry, your kitchen has been “D”-stroyed by microorganisms!

WHAT'S YOUR GRADE? __________

Wash Up and Sing! Wash your hands thoroughly with warm, soapy water prior to preparing food. While washing, sing “Happy Birthday” to yourself. This will ensure you have washed your hands long enough to adequately remove dirt, grime and germs.

Be Careful Crossing the Meat! Wash hands, utensils, plates and cutting boards immediately after they have been in contact with raw meat, poultry, seafood or eggs and before they come in contact with any other food, especially fresh produce.

Microwave it! Microwave sponges and dishcloths on high for one minute to remove any harmful bacteria.

When in Doubt, Throw it Out! If you think something may be old or spoiled, throw it out! Follow the old adage: It’s better to be safe than sorry—or home with a bad stomachache!
OTHER ACTIVITIES

1. Create flyers which encourage handwashing, proper food preparation and storage. Post in restrooms, lunchrooms and in areas where lunchboxes are stored.
2. Submit student-written editorials to your local newspaper on what the public can do to reduce foodborne illnesses.
3. Create a student-made refrigerator magnet that encourages proper food handling and storage.
4. Check your local public health department website and review inspection reports of your favorite local restaurants.

RESOURCES

Food Safety Music
Carl Winter, Ph.D. has combined his passion for music with his expertise in food toxicology to teach students and adults about food safety. Three CDs are available on a donation basis. Appropriate for all ages.
Carl Winter, Ph.D.
Food Science and Technology Department
University of California
One Shields Avenue
Davis, CA 95616-8598
Phone: (530) 752-2647
Fax: (530) 752-4759
E-mail: ckwinter@ucdavis.edu
Website: foodsafe.ucdavis.edu

Science and Our Food Supply—Investigating Food Safety From Farm to Table
Kit includes interactive video, comprehensive reference guide, career guide, and varied activities that can be incorporated into all curricula. Separate guides for middle school and high school science teachers.
National Science Teacher’s Association
Website: www.nsta.org/pdf/hsa.aspx

Your Game Plan for Food Safety: A Fight BAC!®
Food Safety Education Program for 4th, 5th and 6th Grade Classrooms
This comprehensive program includes video, posters, experiments, activities, home survey, take-home BAC-Catchers, and a teacher’s activity and experiment guide.
It is available free from the Fight BAC!® website.
Grades K–3 and 9–12 curricula also available.
Fight BAC!®
Website: www.fightbac.org

LITERATURE


WEBSITES

Alliance for Food and Farming:
www.foodandfarming.info
California Department of Education:
www.cde.ca.gov
California Foundation for Agriculture in the Classroom:
www.LearnAboutAg.org
Centers for Disease Control:
www.cdc.gov
Fight BAC!®:
www.fightbac.org
Food Detectives Fight BAC!®:
www.fooddetectives.com
Food Safety Information and Inspection Service:
www.fsis.usda.gov/food_safety_education
FoodSafe:
foodsafe.ucdavis.edu
Gateway to Government Food Safety Information:
www.foodsafety.gov
MicrobeWorld:
www.microbeworld.org
For additional educational resources, contact CFAITC
2300 River Plaza Drive
Sacramento, CA 95833
(800) 700-AITC (2482)
www.LearnAboutAg.org

California Foundation for Agriculture in the Classroom (CFAITC) is a non-profit, 501(c)(3) organization dedicated to spreading awareness of agricultural literacy and an appreciation for the safe, fresh and abundant agricultural products we are fortunate to enjoy in California. The Foundation provides educators with free and low cost teacher-tested and standards-based resources.
Tasty Testing
Investigate what influences your decision about what you buy to eat.

Preparing Taste Test
1. Explain that consumers make decisions that are influenced by a variety of criteria including appearance, taste, advertising, and cost.

2. Brainstorm a list of criteria that would make a good pear (size, color, variety, taste, texture). Have students vote for which criteria they think is most important.

3. Prepare the pears for the taste test by cutting enough for each student to taste each variety. Serve immediately or treat with lemon juice to prevent browning.

4. Place each pear variety (3-5) on a separate numbered plate.

5. Have students taste each pear and rank them based upon the criteria they determined was the most important.

7. Discuss the results from the taste test.

Classroom Activities
English Language Arts
- Write a new advertising jingle for the winning product highlighting the criteria. Create a 30-second commercial highlighting the product and present it to the class.
- Conduct a market test and write an article with artwork for a consumer report that explains the results. Create a marketing plan, including packaging and target audience.
- Research the career of a marketer. How do these professionals help producers and consumers? Interview someone who has a marketing job.
- If students have a hard time determining what is the most important criteria for the taste tests, have a classroom debate to decide which is the most important.

Materials
- Three to five different kinds of pears
- Small cups for sampling
- Chart paper to collect brainstormed criteria
- Sticky dots or markers for voting

Tip
Try taste tests using other products.

California Standards
Grades 9-12
ELA CC: SL.9-12.1; W.9-12.2

This lesson can be easily adapted to meet the educational standards for a variety of grade levels.
Seed Match

Make one copy of the seed match worksheet for each student. Create your own based on the model or download from LearnAboutAg.org/WEGarden.

1. Have students look at the commodities on the worksheet. Discuss the name of each, determine how each one is part of a healthy diet or used in daily life.

2. Present students with corresponding seeds in an egg carton or sorting box. Discuss the size, shape and appearance of each seed. Have students share their observations.

3. Challenge students to select seeds from the sorter and place each seed on the picture of the commodity to which it corresponds.

4. Cut or break open each whole commodity and locate the seeds within. Allow students to make corrections on the worksheets by moving seeds.

5. Have students glue seeds in correct locations on their worksheets and color each commodity correctly.

6. Count the number of seeds in each commodity. Add up all the seeds in the class. Create math word problems using your results.

Objective: Students will understand that the fruits and vegetables we eat and many materials we use come from flowering plants, and that all flowering plants begin as seeds.

California Standards

**Grade 1:** ELA CC: SL.1.1
Math CC: 1.NBT.1
NGSS: 1-PS4-1, 1-LS1-1

**Grade 2:** ELA CC: SL.2.1
Math CC: 2.OA.1
NGSS: 2-LS2-2

**Grade 3:** ELA CC: SL.3.1
Math CC: 3.OA.1
NGSS: 3-LS1

This lesson can be easily adapted to meet the educational standards for a variety of grade levels. You can also incorporate these seeds into math lessons!

Materials:
- Seed Match worksheet
- Commodities depicted on worksheet
- Seeds from selected commodities
- Egg carton or sorting box
- Crayons or markers
- Glue

Vocabulary:
Help your students brainstorm adjectives to describe seed characteristics.

**Coat:** smooth, rough, dry, wet, spiky, soft, hard, sticky, etc.

**Color:** dark, light, black, brown, white, tan, grey, etc.

**Shape:** oval, round, teardrop, etc.

**Size:** small, medium, large, inches, centimeters, compare to size of a coin, a pencil’s eraser, a water drop, etc.

Other questions: Does it have a scent? What does it sound like when you shake it in a cup or eat it? How does the external covering protect the seed? How might animals help disperse seeds?

This lesson has been adapted from California Foundation for Agriculture in the Classroom curriculum. For additional educational resources, visit LearnAboutAg.org.
<table>
<thead>
<tr>
<th>Seed Match</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Peanut</td>
<td>Cotton</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Watermelon</td>
</tr>
<tr>
<td>Corn</td>
<td>String Bean</td>
</tr>
<tr>
<td>Bell Pepper</td>
<td>Cucumber</td>
</tr>
</tbody>
</table>
CALIFORNIA AGRICULTURE

FARMING IS EVERYWHERE
Hello!

Think about your clothes, paper, shoes, toothpaste, and basketball. Do you ever wonder what these products have in common? They all come from agriculture. California farmers and ranchers produce more than 400 different crops that are made into the things that we use every day.

Today’s farmers work very hard. Did you know that one farmer in the United States can produce enough food to feed 155 people?

Follow your hosts Farmer Joe and Farmer Maria through this coloring book to learn more about agriculture. Have fun seeing and coloring all that agriculture provides—it is more than you could ever imagine!

To learn more visit: LearnAboutAg.org

California’s Top 10 Commodities
Milk, Almonds, Grapes, Cattle, Strawberries, Lettuce, Walnuts, Tomatoes, Pistachios, Hay
Hello there! My name is Farmer Joe, and this is Farmer Maria. Come along as we show you how we all depend on farming. It is all around you!

Here is an easy way to remember what agriculture is:

**The Five F’s**

- **FOOD**
- **FUEL**
- **FIBER**
- **FORESTS**
- **FLOWERS**
Fun Fact

A laying hen produces an average of 250 eggs in one year.
Cotton from plants and wool from animals are types of textile fiber. Many products that we use every day are made from FIBER.

Cotton plants are used to make clothing such as jeans and household items such as towels.

Another plant that is used to produce fiber is flax which is used to make linen.

Some animal fur can be used to make textiles for the production of clothes and other household items. Animals that produce fiber include sheep, alpacas, llamas, and some goats.
Trees from **FORESTS** are used to make more than 5,000 products that we use everyday.

Trees are used to make:
- Paper
- Pencils
- Wood
- Cardboard boxes
- Maple syrup
- Firewood
- Laundry soap
- Tires
- Cosmetics
- Postage stamps
- Baseball bats
- Musical instruments
- Toothpaste
- Nail polish
- Chewing gum

**Fun Fact**

California forests are home to more than 4,000 native plants and 650 wildlife animals.
FLOWERS are a big part of California agriculture. Cut flowers, fruit trees, nursery plants, and house plants are all a part of agriculture.

Fun Fact
Mother’s Day and Valentine’s Day are very popular days to buy flowers.
FUEL can be used to make energy. There are many uses for energy on the farm. Cow manure can be made into FUEL that can heat or cool buildings, or provide lighting and electricity. Corn can be made into ethanol, which is used to fuel cars, trucks and tractors.
Now that you have learned the meaning of **THE FIVE F’S**, it is time to review.

Activity

Match the product with the related “F.”

- **FIBER**
- **FORESTS**
- **FOOD**
- **FLOWERS**
- **FUEL**
There's a Farm in My Pizza?

Follow the trail of how pizza is made, from the farm to the parlor.

It all starts on the farm. Farm workers grow wheat, tomatoes, olives and vegetables. They raise dairy cows for milk and pigs for meat.

Workers turn some products into the food people eat.
- Wheat is milled into flour for the crust.
- Tomatoes are cooked into sauce.
- Milk is made into cheese.
- Olives and vegetables are prepared and packaged.
- Sausage comes from pigs.

Chefs cook the pizza—just the way you like it!

Farm workers spend time growing and harvesting our food.

Truck drivers transport the products to be processed.

Color this pizza with your favorite toppings!
FARMERS MARKETS have existed since we began farming 10,000 years ago. Historically, when families produced more food than they needed, they would meet in the town square to sell or trade their excess commodities. Farmers Markets became a traditional way of selling local agricultural products.

How many items can you find that would be sold at a Farmers Market?

S T U N L A W P U S S T D J T
C E L M S S E M G B E Y G R R
Q P T L H A I K V S K V X L K
T O J A C A B N O E O D I K F
F R A H N S A I D T H I D L S
H N E T M A H I J A C U T G O
R S Z U U C R H D D I F I G S
F I L Z A L A G T G T E R C P
Q P C T M A H L E G R R A K M
C M S E J U V I M M A W I K Z
K I W I F R U I T O O J S X J
P A M W Q C B E Z O N P I J E
K F S G T L Q J M Q D D N K R
G U I P O G H Y Y T W A S O O
V O A K Z D I T K T G W Q R V

Word Bag
ALMONDS
ARTICHOKE
DATES
FIGS
KIWIFRUIT
OLIVES
PEACHES
PISTACHIOS
PLUMS
POMEGRANATES
RAISINS
RICE
WALNUTS
Farming is Everywhere

Top 3 Crops by County

**Alameda** Grapes, Cattle & Calves, Woody Ornaments
**Alpine** Cattle & Calves, Pasture & Range, Hay other
**Amador** Grapes, Cattle & Calves, Pasture & Range
**Butte** Almonds, Walnuts, Rice
**Calaveras** Cattle & Calves, Pasture & Range, Grapes

**Colusa** Almonds, Rice, Walnuts
**Contra Costa** Cattle & Calves, Corn, Tomatoes
**Del Norte** Cows, Milk, Nursery Bulbs
**El Dorado** Apples, Cattle & Calves, Grapes
**Fresno** Almonds, Livestock, Milk
**Glend** Almonds, Walnuts, Rice
**Humboldt** Cattle & Calves, Nursery Products, Milk
**Imperial** Heifers & Steers, Alfalfa Hay, Onions
**Inyo** Steers, Alfalfa Hay, Heifers
**Kern** Grapes, Almonds, Milk
**Kings** Milk, Cotton, Cattle & Calves
**Lake** Grapes, Pears, Walnuts
**Lassen** Hay other, Alfalfa Hay, Vegetables
**Los Angeles** Woody Ornaments, Vegetables, Nursery Bedding Plants
**Madera** Almonds, Milk, Pistachios
**Marin** Milk, Cattle & Calves, Poultry
**Mariposa** Cattle & Calves, Pasture & Range, Livestock Products
**Mendocino** Grapes, Cattle & Calves, Pears
**Merced** Milk, Almonds, Cattle & Calves
**Modoc** Alfalfa Hay, Cattle & Calves, Potatoes
**Mono** Alfalfa Hay, Steers, Field Crops
**Monterey** Strawberries, Head Lettuce, Romaine Lettuce
**Napa** Grapes, Nursery Products, Cattle & Calves
**Nevada** Heifers & Steers, Milk Cows, Pasture & Range
**Orange** Woody Ornaments, Strawberries, Fruits & Nuts
**Placer** Rice, Cattle & Calves, Nursery Products
**Plumas** Cattle, Alfalfa Hay, Pasture
**Riverside** Milk, Woody Ornaments, Grapes
**Sacramento** Grapes, Milk, Pears
**San Benito** Vegetables, Lettuce, Spinach
**San Bernardino** Milk, Eggs, Alfalfa Hay
**San Diego** Woody Ornaments, Flowers, Nursery Bedding Plants
**San Francisco** Field Crops, Apiary Products
**San Joaquin** Almonds, Milk, Walnuts
**San Luis Obispo** Grapes, Strawberries, Cattle & Calves
**San Mateo** Potted Plants, Nursery Products, Brussels Sprouts
**Santa Barbara** Strawberries, Grapes, Broccoli
**Santa Clara** Mushrooms, Nursery Products, Woody Ornaments
**Santa Cruz** Strawberries, Raspberries, Nursery Products
**Shasta** Hay, Forest Products, Cattle
**Sierra** Cattle, Pasture, Alfalfa Hay
**Siskiyou** Nursery Plants, Alfalfa Hay, Heifers & Steers
**Solano** Processing Tomatoes, Walnuts, Alfalfa Hay
**Sonoma** Grapes, Milk, Poultry
**Stanislaus** Almonds, Milk, Walnuts
**Sutter** Walnuts, Rice, Dried Plums
**Tehama** Walnuts, Almonds, Olives
**Trinity** Timber, Livestock, Grapes
**Tuolumne** Livestock, Cattle & Calves, Pasture & Range
**Ventura** Strawberries, Lemons, Raspberries
**Yolo** Processing Tomatoes, Almonds, Walnuts
**Yuba** Walnuts, Rice, Dried Plums

Circle the county you live in and identify the top crops.
Food labels tell you the nutritional content of a food item. You can compare two different items by using the Nutrition Facts label to choose the healthier option.

Use the Nutrition Facts label to compare food choices. The example above shows two soup options. The Nutrition Facts labels show us that the reduced-sodium vegetable soup has less sodium per serving than the original vegetable soup — in this case half the amount. This makes the reduced-sodium vegetable soup the healthier choice, as long as the serving sizes are about the same size.
Let's talk trash.

Cut back on **food waste and loss** to save money, improve access to food, and protect natural resources.

About **90 billion** pounds of edible food goes uneaten each year.*

That weighs **123x** the Empire State Building.

This cost consumers **$370** per person each year.

**KEY:**
- = $1
- = $5
- = $20

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Wasted Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>$22</td>
</tr>
<tr>
<td>Fruits</td>
<td>$45</td>
</tr>
<tr>
<td>Protein Foods**</td>
<td>$140</td>
</tr>
<tr>
<td>Vegetables</td>
<td>$66</td>
</tr>
<tr>
<td>Dairy</td>
<td>$60</td>
</tr>
<tr>
<td>Added Fat &amp; Sugar</td>
<td>$37</td>
</tr>
</tbody>
</table>

*Amount of each food group wasted.
Reduce wasted food in your home with simple shopping, storage, & cooking practices.

**Plan & Save**
Plan your weekly menu and make a grocery list. Does the list include food that you already have at home? Buy only what you need and stay within your budget.

**Be Food Safe**
Shop refrigerated or frozen foods just before checking out. Transport items that spoil easily in a cooler or thermal bag and refrigerate or freeze within two hours of shopping.

**Check for Quality**
The date on a food package helps the store determine how long to display the product for sale. It can also help you to choose a product at its best quality.

**Set Storage Reminders**
Track storage times for different foods using The FoodKeeper Application. This tool will remind you when foods are near to the end of their storage date.

**Be Organized**
Foods are less likely to go bad when you use the older items first. Keep your pantry and refrigerator clean and organized so you can see what needs to be eaten first.

**Re-purpose**
Give leftovers a makeover when you reuse them in recipes. Add broccoli stems to a salad or blend overripe fruit into a low-fat smoothie. Freeze extra food.

**Donate**
Many shelters, food banks, and faith-based organizations will accept food donations to feed others who need a meal.

**Recycle & Compost**
Instead of throwing out food, create a compost bin. Don’t have a yard? Your city may help you find composting or recycling options that are right for you.

Sources:
All sources are available at ChooseMyPlate.gov/lets-talk-trash.

*In homes and away-from home eating places.
**Protein foods includes meat, poultry, fish, eggs, and nuts.
Fruits and vegetables come in many different forms. Fresh, frozen, canned, dried – even 100% juice. They’re all good for you!

Put a check mark (✓) next to each form you find for the fruits and veggies listed:

<table>
<thead>
<tr>
<th></th>
<th>Fresh</th>
<th>Canned</th>
<th>Frozen</th>
<th>Dried</th>
<th>100% Juice</th>
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<tbody>
<tr>
<td>Carrots</td>
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<td>Oranges</td>
<td></td>
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<tr>
<td>Corn</td>
<td></td>
<td></td>
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<tr>
<td>Apples</td>
<td></td>
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<td>Spinach</td>
<td></td>
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<td>Apricots</td>
<td></td>
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<td>Bananas</td>
<td></td>
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<td>Cranberries</td>
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<td>Grapes</td>
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<td>Strawberries</td>
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<td>Pineapples</td>
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Were you able to find any fruits or vegetables in all 5 forms? Name them here:  _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
It's important to eat a variety of colorful fruits and vegetables every day. See if you can find 5 different fruits and vegetables in each of these colors. Write your answer in the space provided.

<table>
<thead>
<tr>
<th>Colors</th>
<th>Fruits and Veggies</th>
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<tbody>
<tr>
<td>Red</td>
<td>1. __________  2. __________  3. __________  4. __________  5. __________</td>
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<tr>
<td>Blue/Purple</td>
<td>1. __________  2. __________  3. __________  4. __________  5. __________</td>
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<tr>
<td>Yellow/Orange</td>
<td>1. __________  2. __________  3. __________  4. __________  5. __________</td>
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<tr>
<td>Green</td>
<td>1. __________  2. __________  3. __________  4. __________  5. __________</td>
</tr>
<tr>
<td>White</td>
<td>1. __________  2. __________  3. __________  4. __________  5. __________</td>
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</tbody>
</table>
I’m Stuck on Fruits & Veggies

Collect the PLU stickers from each piece of fruit or veggie you eat at home. Place them on a space on this card. (You can tape the sticker to the card, if needed.)

When your card is full, give it to Mom and Dad for a special treat, then begin another card!

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Eat a colorful variety of fruits and veggies from all 5 color groups every day to stay healthy and fit!