More Than A Meal

FCS Reader Teachers Guide

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NEBRASKA AGRICULTURE IN THE CLASSROOM
NEBRASKA FARM BUREAU FOUNDATION

Agriculture in the Classroom is a program coordinated by the National Agriculture in the Classroom Organization. In Nebraska, the Agriculture in the Classroom program is managed by the Nebraska Farm Bureau Foundation whose mission is to engage youth, educators, and the general public to promote an understanding of the vital importance of agriculture in the lives of all Nebraskans. To learn more or access an electronic version of this publication contact the Nebraska Farm Bureau Foundation.

www.nefbfoundation.org | (402) 421-4747 | foundationforag@nefb.org | 5225 South 16th Street, Lincoln, NE 68512

Dive Deeper

Nebraska's Resources

For corresponding reading, check out Page 1 of More Than a Meal

HSE.HS.21.2.c | *Identify issues surrounding global production of food and how sustainability and conservation practices are connected.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***What natural resources and environmental features in Nebraska allow us to produce so many agricultural goods?***

Dive Deeper

Value-Added

For corresponding reading, check out Page 2 of More Than a Meal

HSE.HS.21.2.b | *Analyze farm to table for a variety of food products grown locally and globally.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***How do processing and transportation "add value" to pigs as an agricultural product?***

Dive Deeper

The 4 Cs in My Kitchen

For corresponding reading, check out Page 3 of More Than a Meal

HSE.HS.19.5.f | *Demonstrate safe preparation/heating/storage methods on a variety of food products.*

Directions:

Students read about the 4 Cs of at-home food safety and answer the following question in a notebook: ***When preparing food, which of the 4 Cs are you most likely to adhere to? Which of the 4 Cs most often gets neglected and why?***

4 Cs of At-Home Food Safety:

1. Clean your hands with warm water and soap for at least 20 seconds.
2. Utilize different cutting boards and utensils to keep raw meat and eggs separate from vegetables and fruits. This helps avoid cross-contamination!
3. Cook your meat to the recommended safe internal temperature by measuring it with a food thermometer.
4. Chill leftover foods within two hours. Thaw frozen foods in the refrigerator, cold water, or microwave and package warm or hot foods into several shallow containers to refrigerate.

Dive Deeper

Label Claims

For corresponding reading, check out Page 4 of More Than a Meal

Supports HSE.HS.21.4.d | *Identify package labeling components.*
Supports HSE.HS.21.4.e | *Analyze the Nutrition Facts label to determine nutrient contributions of a variety of foods.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***Find your favorite ice cream online and examine the Nutrition Facts label and ingredients list. Share with the class an interesting fact you discovered. List below a nutrient that can come from this ice cream product.***

Dive Deeper

Food Labels: Why Do They Matter?

For corresponding reading, check out Page 5 of More Than a Meal

Supports HSE.HS.21.4.d | *Identify package labeling components.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***Imagine if all foods were packaged in plain, clear packaging without any personalized brands or additional food label claims.***

Then answer, ***"What are the benefits of unique food labels and various food label claims***
...to the farmer?
...to the food processing company?
...to the consumer?"

Alternatively, what might be some of the downfalls of the variety of food labels we see on our shelves?

Dive Deeper

Food Decisions

For corresponding reading, check out Page 6 of More Than a Meal

HSE.HS.32.6.b | *Summarize the effects of social determinants on personal food choices, food systems, and public health.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***Evaluate your ranking of food-purchasing factors on page 6 of More Than a Meal:***

___ Price
___ Convenience
___ Health benefits
___ Taste
___ Company ethics/values
___ Label appearance
___ Social norms (family traditions, peer pressure, cultural backgrounds)

How do you purchase food most often? How might your food decisions change throughout your life?

Dive Deeper

Shopping in a Different Setting

For corresponding reading, check out Page 6 of More Than a Meal

HSE.HS.32.6.c | *Explain the impact of cultural influences on food consumption and traditions within family units.*
HSE.HS.32.6.d | *Analyze the impact of the rising cost of food, poverty, food deserts, food insecurity, and the growing world population on individuals, families, communities, and society.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***How is grocery shopping different in other parts of Nebraska?*** *(Think about a bigger city, smaller town, or more rural setting.)* ***What impact does that have on a family or community's overall nutrition and lifestyle?***

Dive Deeper

Sustainability Challenges

For corresponding reading, check out Page 7 of More Than a Meal

Supports HSE.HS.21.2.c | *Identify issues surrounding global production of food and how sustainability and conservation practices are connected.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***Sustainability means producing enough food for today's needs without compromising the ability of future generations to do the same. What challenges do you think agricultural producers face as they seek to raise food in a sustainable way?***

Dive Deeper

Don't Waste That!

For corresponding reading, check out Page 8 of More Than a Meal

HSE.HS.21.4.d | *Identify package labeling components.*

Directions:

In a notebook, students answer the "Dive Deeper" prompt: ***What's been your experience with open food dating phrases such as "Use by…" Do you usually throw outdated foods out? Do you understand what these phrases mean?***

THE RIGHT ENVIRONMENT

Adapted from National Agriculture in the Classroom Curriculum Matrix

For corresponding reading, check out Page 1 of More Than a Meal

HSE.HS.21.2.c | *Identify issues surrounding global production of food and how sustainability and conservation practices are connected.*

Supplies Needed:

- Where Does It Grow? cards, 1 copy per class, cut into individual cards
- World map to project on a whiteboard
- Geography and Climate for Agricultural Landscapes handout, 1 copy per student
- Where Is It Grown: orange example, 1 copy per student or projected onto the board
- Maps, displayed on projector:
  - Hog and Corn Production: https://nefbmap.org/map.php?M=7&MV=0&P=39&PV=0
  - Farmer-Operator and Geographic Area: https://nefbmap.org/map.php?M=0&MV=0&P=44&PV=0
  - Beef Cow and Geographic Area: http://www.nefbmap.org/map.php?M=0&MV=0&P=35&PV=0
  - Beef Cow and Acres of Pastureland: http://nefbmap.org/map.php?M=43&MV=0&P=35&PV=0
  - Rainfall and Beef Cow: http://nefbmap.org/map.php?M=35&MV=0&P=50&PV=0
  - Milk: http://www.nefbmap.org/map.php?P=28&PV=0

Directions:

1. On the day prior to class, give each student one Where Does it Grow? card. Assign them homework to visit their local grocery store and find out where their assigned fruit or vegetable was grown. Give students the following tips:
   - If it was grown outside of the United States, it will have a sticker or label indicating the country where it was produced.
   - Packaged produce (like baby carrots or bags of apples) often lists the name and city or state of the farm where it was grown.
   - Loose produce, if grown in the United States, doesn't always have an individual label indicating its origin. Students can ask a produce worker to check the shipment boxes, which often have the name and location of the farm.
   - If students exhaust the options above and cannot find an origin of their assigned fruit or vegetable, they should do a Google search and list the top three states (or countries) where it is grown.
2. At the beginning of class, project a map of the world on the board. Place a star on the map indicating "you are here."
3. Instruct students to tape their fruit/vegetable/crop card to the board on the state or country where it was produced. Remind students that most, if not all, of these food items are available at a grocery store nearby. As you review the map, ask questions such as:
   a. Which foods are grown closest to us?
   b. Which foods are grown farthest away?
   c. Are there any foods that are currently out of season where we live? If so, are there any commonalities regarding the origin of out-of-season fruits and vegetables?
   d. Are there any foods that we do not grow in the United States?

Activity 1

1. While the Where Does it Grow? cards are still on the map/board, ask, "How do geography and environmental resources impact food production?" Allow students to brainstorm answers using their prior knowledge. If needed, provide guiding questions:
   - Why are oranges (or another tropical fruit) grown in subtropical or tropical locations instead of Colorado or Nebraska? (Climate. Citrus fruits do not tolerate cold temperatures.)
   - Why aren't bananas grown in the temperate United States? (Bananas grow in a tropical climate.)

- If you are in an urban city, ask why the food doesn't grow here. (Little/no space for farming.)
- Teacher Tip: Additional guiding questions will be dependent on the current season and where you live.

2. Give each student one copy of the Geography and Climate for Agricultural Landscapes handout.
3. Use the handout to discuss four factors (climate, soil, water, and open space) that impact where food is grown.
4. Instruct each student to retrieve their Where Does it Grow? card from the board and glue or tape it to their handout.
5. Next, have them research their fruit/vegetable/crop to see if it could be grown locally. Students should describe the availability of each resource and indicate if your local geography could support a farm to grow that crop. Share the example page of growing oranges in Chicago, Illinois.
   - Teacher Tip: It may be difficult for students to find out what type of soil is in your local area with an internet search. As an alternative, have them find the type of soil their crop prefers and then ask them to consider if the other three required factors are met.
6. After the students have completed page one of the handout, have them share their findings. Make a list of foods you could and could not consume if you were only to eat produce grown in your state.

Activity 2

1. Now that students recognize how geography impacts crop production, ask, "Does geography impact the livestock that produce the meat, milk, and eggs we eat?" Allow students to begin thinking and then prompt them to read page two of their Geography and Climate for Agricultural Landscapes handout.
2. Use the following three examples to illustrate geographic and agricultural correlations in the production of animal-source foods.
3. **Connection #1: Resource Availability.** Hog production is an example of an agricultural commodity being produced in the same area as one of its necessary resources. Pigs are raised for their meat, known as pork. Their primary diet is corn. Display the Hog and Corn Production Maps. Ask your students the following questions:
   - What are the top five hog-producing states? (Iowa, North Carolina, Minnesota, Illinois, and Indiana)
   - What are the top five corn-producing states? (Iowa, Illinois, Nebraska, Minnesota, and Indiana)
   - Is there a correlation between hog production and corn production? Why? (Yes. Corn is the primary diet for pigs. It is economical to raise pigs close to where their feed is grown. This decreases production costs for the farmer, allowing the cost of food to be lower.)
4. **Connection #2: Available Space.** Space is necessary for farmers to raise animals and grow crops. As a class, compare the Farmer-Operator and Geographic Area Maps. Notice that California and Texas are among the largest-sized states and have some of the highest numbers of farmers. Display and study the Beef Cow and Geographic Area Maps and the Beef Cow and Acres of Pastureland Maps. Ask your students the following questions:
   - Can you see any correlations between geographic areas of a state and their beef cattle production? (Yes. Beef cattle require more living space than other livestock species. Most beef cattle spend most of their lives grazing pastures and rangelands. Larger states have a higher likelihood of having fields, pastures, and rangelands for cattle to graze.)
   - Notice that Nevada, Arizona, Utah, and New Mexico rank among the largest states, but they are not among the higher producing states of beef cattle. Can you guess what one limiting factor might be? (Moisture. If your students need a clue to answer this question, show them the Rainfall and Beef Cow Maps. These four states are located in a desert region and have some of the driest overall conditions. Lack of rainfall decreases the amount of grazing land available for cattle to feed on, thus decreasing the total number of cattle that can be raised per acre.)
5. **Connection #3: Access to Markets and Processing Facilities.** Animal-source foods must be processed and prepared for retail sale. For example, meat needs to be cut and packaged, eggs need to be washed and placed in cartons, and milk needs to be processed. Show students the Milk Map. Ask students what they notice about the distribution of dairy farms across the United States. Point out that unlike some other commodities, milk is produced in every state. Milk is a perishable product with a shorter shelf life than many other foods. It is produced in closer proximity to consumers.

Supplies Needed:

After conducting these activities, review and summarize the following key points:

- Geographic components such as climate and natural resources determine the type of crops and livestock that can be grown and raised in a particular area.
- Relying on locally grown foods has both pros and cons. It supports local economies but may limit the variety of foods that can be consumed for a balanced diet, depending on where you live.
- Consuming foods from national and international sources can increase cost efficiency, allowing the food to be produced in the ideal location and then be shipped to consumers.

WHERE IS IT GROWN?

Spinach

Where is it grown?

Avocado

Where is it grown?

Bell Pepper

Where is it grown?

Corn

Where is it grown?

Carrot

Where is it grown?

Potato

Where is it grown?

Peas

Where is it grown?

Green Bean

Where is it grown?

Asparagus

Where is it grown?

Mushroom

Where is it grown?

Pineapple

Where is it grown?

Blackberry

Where is it grown?

Pear

Where is it grown?

Kiwi

Where is it grown?

Cherry

Where is it grown?

Grape

Where is it grown?

Cantaloupe

Where is it grown?

Peach

Where is it grown?

Raspberry

Where is it grown?

Blueberry

Where is it grown?

Lemon

Where is it grown?

Grapefruit

Where is it grown?

Watermelon

Where is it grown?

Banana

Where is it grown?

Apple

Where is it grown?

Orange

Where is it grown?

Mango

Where is it grown?

Strawberry

Where is it grown?

Tomato

Where is it grown?

Celery

Where is it grown?

Cabbage

Where is it grown?

Onion

Where is it grown?

Sweet Potato

Where is it grown?

Squash

Where is it grown?

GEOGRAPHY AND CLIMATE FOR AGRICULTURAL LANDSCAPES

Plant-source Foods: A typical American diet consists of a wide array of fruits, vegetables, grains, nuts, dairy, and meat products. Each food item was produced on a farm that could be located relatively nearby, or it could have been produced across the nation or even globe depending on where you live. Consider the following geographical factors that influence the production of plant-source foods:

Climate plays a large role in the production of plant-based foods. Every plant has its own climate requirement for productive growth. For example, citrus fruits such as oranges, grapefruit, lemons, and limes require a tropical or subtropical climate. In the United States citrus fruits are grown primarily in Florida and Southern California. Tropical fruits such as pineapple, mangos, passionfruit, and papaya can only be grown in Hawaii or countries outside of the United States. Other berries and fruits such as strawberries, raspberries, peaches, and melons can be grown in more temperate climates as long as the length of the growing season is sufficient for the plants to produce their fruit. Other crops prefer cooler climates such as wheat, potatoes, sugar beets, and many vegetables such as broccoli, onions, lettuce, carrots, and spinach.

Soil across the country has different properties that affect its ability to supply nutrients, hold water, and to ultimately support food production. Sandy soils under some conditions will not hold enough water. However, clay soils might hold too much water which could lead to plant loss. Soil fertility refers to the quality of a soil that allows it to provide adequate amounts of nutrients in the proper balance to support healthy plant growth. Fertile soil contains the correct balance of organic matter, lies with a specific pH range, cycles nutrients, and hosts a community of microorganisms.

Water is an essential resource for the growth of plants. Water requirements vary from crop to crop with some crops requiring a lot of water and others requiring relatively little water. For example, rice is a staple food crop that requires a lot of water. Rice fields can actually be submerged in water for part of the growth season. Geography impacts both water supply and the availability of fresh water.

Open space is another important factor to consider in evaluating a state's capability to produce their own food. In some areas, residential populations or businesses are too dense for a traditional farm which requires space for fields and plant growth. Even more important than simply open space is to consider if the space has arable land.

Can your fruit or vegetable be grown locally? If not, discover the limiting factor(s).

Climate:

Soil:

Place your
Where does it grow?
Card here.

Water:

Open Space:

Animal Source Foods: The livestock that produce our meat, eggs, and milk are slightly more adaptable to various climates and conditions, especially with the use of modern animal husbandry practices which provide temperature controlled buildings and shelters in unsuitable weather. However, consider the following geographical factors that influence the production of animal-source foods.

Resource Availability. Animals raised on farms for the production of meat, milk, and eggs require adequate feed and appropriate shelter for the climate and weather conditions. There is often a geographic correlation between the location of livestock farms and where their feed was produced. For example, pigs eat a mixture of corn and soybeans. Iowa produces more pork and corn than any other state. Among other factors, it is an economical choice to raise pigs close to where their feed is produced to eliminate shipping costs.

Open space. Livestock animals are raised in a variety of places. Beef cattle and sheep spend a large portion of their lives grazing on public or private rangelands. Many pigs and poultry animals are housed in climate-controlled indoor barns that may require relatively less space for animal housing, but also require locations that meet zoning requirements and provide for proper manure and environmental management.

Access to markets and processing facilities. While many livestock farms are located in remote or rural areas, they also need to have efficient access to processing and distribution facilities. For example, milk is a perishable food product. It is transported from the dairy farm to a processing plant where the milk is pasteurized and either bottled or processed into cheese, butter, or other dairy products. Close geographical proximity is helpful for cost efficiency as well as practicality.

WHERE IS IT GROWN: ORANGE EXAMPLE

Climate:

Orange trees need temperatures between 55 and 100 degrees and winter temperatures above freezing. It's too cold to grow oranges in Illinois..

Water:

Chicago gets an average of 38 inches of rain per year which would be adequate for an orange orchard.

Orange

Where is it grown?

California

Soil:

Orange trees don't do well with heavy clay soils. They need well-drained soil.

Open Space:

Open space right in Chicago would be difficult or impossible to find.

BROWNIE COMPARISON

For corresponding reading, check out Page 1 of More Than a Meal

HSE.HS.21.6.a | *Demonstrate foundational culinary techniques (measuring, knife skills, folding, creaming) and correct use of kitchen equipment.*
HSE.HS.19.7.b | *Compare and contrast flavor, texture, aroma, and appearance of various foods.*

Supplies Needed:

- Dry Beans 101 handout, 1 per student
- Nutritional Value of Dry Beans handout, 1 per student
- Taste Test Comparison worksheet, 1 per student
- Brownie baking supplies, see recipes
- Brownie recipes, printed as needed

Directions:

*Note: The Engage" and Background Information components of this activity may need to be completed ahead of time in a separate class period to allow enough time for brownie baking. Additionally, the brownie sampling will likely need to happen in the next class period after baking to allow cooling time.

Engage

As students enter the classroom, have the words "Bean Brownies" displayed in large print on a whiteboard or projector. Ask students to share their initial perceptions of bean brownies with their neighbor. Discuss together as a class.

a. What is your initial perception of bean brownies?
b. Has anyone ever eaten brownies with dry edible beans in them?
c. What might be the benefit of adding beans to a dessert like brownies?
d. How open are you to trying new foods?

Background Information

1. Distribute the Dry Beans 101 handout to each student. Read together as a class.
2. Distribute the Nutritional Value of Dry Beans handout to each student. In small groups, students skim the article, specifically highlighting or underlining the nutritional benefits associated with dry edible beans.
3. Discuss:
   a. Did you know dry edible beans are grown in Nebraska?
   b. What kind of dry edible beans have you consumed? How were they prepared?
   c. What are some of the key nutritional benefits of beans?

Activity

Depending on the facilities and supplies available and the number of students in the class, students will bake bean brownies and complete the taste test worksheet. Ideas:

a. Bake one batch of bean brownies as a class and complete the taste and texture analysis together.
b. Divide students into three groups. Each group bakes a different kind of brownie: flour, black bean, or white bean blondies. Sample the various brownies and have students complete the comparison worksheet.
c. Bake flour brownies ahead of time as the "control." Divide students into two groups to each bake a different kind of brownie: black bean and white bean blondie brownies.

DRY BEANS 101: DRY BEAN VARIETIES GROWN IN NEBRASKA

Information taken from the Nebraska Dry Bean Commission

Nebraska is the #1 producer of great northern beans in the United States.

GREAT NORTHERN

Description: Mediumsize, white color, oval shape; mild flavor with a powdery texture.

Cooking Time: 1½ hours.

Comments: Belongs to the white bean or haricot bean family.

Uses: Most often used in soups, stews, and cassoulet.

LIGHT RED KIDNEY

Description: Large, kidney-shaped bean; robust, full-bodied flavor and soft texture.

Cooking Time: 1½ to 2 hours.

Comments: Also called Mexican bean.

Uses: Most often used in chili; popular in salads and with rice.

Nebraska is the #2 producer of pinto beans in the United States.

PINTO

Description: Medium ovals, mottled beige and brown color; earthy flavor and powdery texture.

Cooking Time: 1½ to 2 hours.

Comments: When cooked, they lose their mottling and turn light brown or tan.

Uses: Most often used in refried beans; great for Tex-Mex and Mexican bean dishes.

BLACK

Description: Medium, black-skinned ovals; earthy, sweet flavor with a hint of mushrooms.

Cooking Time: 1½hours.

Comments: Also called turtle bean, Mexican black bean, and Spanish black bean.

Uses: Most often used in thick soups or with rice; basic for many Mexican, Caribbean, and Latin American soups and side dishes.

PINK

Description: Small, pale, pink-colored; rich, meaty flavor with a slightly powdery texture.

Cooking Time: 1 hour.

Comments: Related to the kidney bean; turns reddish brown when cooked.

Uses: Often used in chili; a favorite in Old West recipes.

NAVY

Description: Small white ovals; mild flavor with powdery texture.

Cooking Time: 1½ to 2 hours.

Comments: Also known as pea beans.

Uses: Most often used in pork and beans or baked beans; used in soups and stews; great pureed.

Nutritional Value of Dry Beans

Susan Raatz, PhD, MPH, RD
Research Nutritionist, USDA Human Nutrition Research Center, Grand Forks, North Dakota.

Throughout history, dry beans have been used as a staple of the diet, and the health benefits derived from them have been well recognized. Documentation of their use goes back far into the past, long before biblical times. Evidence of dry bean use in Southeast Asia, the Middle East, Africa, the Americas, India and China is available from archeological evidence.

Most Americans are not eating enough beans, although people in the southern and western regions of the United States consume more than those in the Midwest and Northeast, even though half of the beans grown in the country are from North Dakota and Michigan. Americans consume, on average, about 6.5 pounds of dry beans yearly which is equal to 56 g/week or a little more than one quarter of the 2005 Dietary Guidelines for Americans' recommendation of 3 cups of beans per week (dry weight ~200 g).

Dry beans are nutrient-dense in that the amount of nutrients provided per calorie is particularly high. Increased intake will provide nutritional benefits to the diet, and may help to reduce disease risk and enhance longevity. In a recent multicultural study, the consumption of beans was shown to be the only dietary component related to longevity. In a study called the "Food Habits in Later Life Study," investigators found that for every 20 g intake of legumes (including dry beans), the risk ratio of death was reduced by 6% in the older people (aged 70 and older) studied.

Dry Beans are Nutritionally Rich

Although dry beans vary considerably in flavor, size, color, and shape, their nutritional composition is remarkably similar. (Table 1 provides an example of the nutrient content of cooked dry beans.) They are packed with protein, carbohydrates, vitamins and minerals, and are low in fat. One half cup of cooked dry beans contains approximately 115 calories and provides 8 grams of protein. In addition to macronutrients, vitamins and minerals, dry beans contain several types of phytochemicals. They are rich in lignans, which may play a role in preventing osteoporosis, heart disease, and certain cancers. The flavonoids in beans may help reduce heart disease and cancer risk. The plant stanol esters, or phytosterols, contained in dry beans may help reduce blood cholesterol levels.

Dry Beans Provide Complex Carbohydrates

Sixty to 65% of the calories in dry beans are from carbohydrates, predominantly in the form of starch, resistant starch, and small amounts of non-starch polysaccharides. Dry beans have a low glycemic index, with values varying from 27–42% relative to glucose and 40–59% relative to white bread. The reduced glycemic index of dry beans helps reduce the glycemic load of the diet when served in a mixed meal. The properties of the carbohydrates found in dry beans,

continued on pg. 2

Table 1: Nutritional Values of Black Beans, Cooked

Serving Size: 1/2 cup	Thiamin: <1 mg
Calories: 113	Folic Acid: 128 mcg
Fat: <1 g	Copper: <1 mg
Saturated Fat: <1 g	Iron: 2 g
Cholesterol: 0 mg	Magnesium: 60 mg
Carbohydrate: 20 g	Manganese: <1 mg
Protein: 8 g	Phosphorus: 120 mg
Dietary Fiber: 8 g	Potassium: 306 mg
Sodium: 1 mg	

along with their fiber content, make them ideal foods for the management of abnormalities associated with insulin resistance, diabetes and hyperlipidemia.

Beans contain some complex sugars of the raffinose family. These are the sugars that cause digestive issues with bean consumption. These sugars must be broken down by enzymes that are not available in the human digestive system and are therefore available for microbial action in the colon, resulting in gas production and flatulence. These sugars can be removed effectively from the beans by soaking the beans, and then cooking them, discarding the soaking and cooking liquids.

Dry Beans Provide Beneficial Dietary Fiber

Dry beans are rich in both soluble and insoluble fibers, so they provide the nutritional benefits of both fiber classes. The soluble fiber in beans dissolves in water, trapping bile which helps to lower blood levels of LDL cholesterol, especially if LDL cholesterol levels were high to begin with, without compromising the level of protective HDL cholesterol. Dry beans also provide substantial amounts of insoluble fiber, which help attract water to the stool and enhance transit time of waste through the colon. This may help to combat constipation, colon cancer, and other conditions that afflict the digestive tract.

Dry Beans are a Major Source of Dietary Protein

Dry beans are very good source of low fat protein. They contain between 21 to 25% protein by weight, which is much higher than other vegetable products. In many parts of the world, they provide a substantial proportion of the total protein intake for the population. The intake of dried beans as a protein source is extremely important worldwide as they provide a good source of protein at minimal cost relative to the production of animal protein sources.

Dry Beans are Low in Fat

The fat content of dry beans is very low (less than 2% of total content), and they contain predominately unsaturated fatty acids. There is some variation based on variety and growth conditions, but most beans contain about 85% of their fat as unsaturated fatty acids. Because dry beans are plant foods, they are cholesterol-free.

Dry Beans are Plentiful in Vitamins and Minerals

As for vitamins and minerals, beans are an excellent source of copper, phosphorus, manganese and magnesium—nutrients that many Americans don't get enough of. Most dry beans are a rich source of iron, which makes them ideal for vegans who do not get an animal source of iron. The nutritional content of most dry beans is very similar, with the exception of iron content. White beans have almost twice the iron of black beans, while kidney beans are somewhere in between.

Dry beans are an excellent source of the water-soluble vitamins thiamin and folic acid and a good source of riboflavin and vitamin B6.

Summary

Nutrient dense dry beans are an important addition to the diet. They are low in fat, high in fiber and packed with protein. Dry beans provide a rich source of vitamins and minerals as well as plant phytochemicals. Including 3 cups of cooked dry beans in the diet on a weekly basis will meet the U.S. Dietary Guidelines for Americans. In addition, they will enhance health-promoting aspects of the diet and be important in reducing risk for chronic diseases such as obesity, cancer, diabetes and heart disease.

FUDGY BLACK BEAN BROWNIES

Recipe taken from The Bean Institute by the Northarvest Bean Growers Association (NBGA): https://beaninstitute.com/recipes/fudgy-black-bean-brownies/

Ingredients:

- 1 15-ounce can black beans, drained and rinsed
- 3 large eggs
- 3 tablespoons applesauce or canola oil
- ¾ cup granulated sugar
- ½ cup unsweetened cocoa powder
- 1 teaspoon vanilla extract
- ½ teaspoon peppermint extract, optional
- ½ teaspoon baking powder
- pinch of salt
- ½ cup mini semi-sweet chocolate chips, divided

Instructions:

1. Preheat the oven to 350°F. Lightly oil or coat an 8 X 8-inch baking pan with nonstick cooking spray and set aside.
2. Place the black beans in the bowl of a food processor and process until smooth and creamy. Add the eggs, applesauce, sugar, cocoa powder, vanilla, peppermint extract as desired, baking powder, and salt. Process until smooth. Add ¼ cup of the chocolate chips and pulse a few times until they are incorporated.
3. Pour the batter into the prepared pan, smooth the top with a rubber spatula, and sprinkle with the remaining ¼ cup chocolate chips.
4. Bake 30 to 35 minutes, or until the edges start to pull away from the sides of the pan and a toothpick inserted in the center comes out clean. Cool in the pan before slicing into squares.

WHITE BEAN BLONDIES

Recipe taken from Gluten Free on a Shoestring: https://glutenfreeonashoestring.com/white-bean-blondies/#wprm-recipe-container-66922

Ingredients:

- 1 15-ounce can great northern Beans, drained and rinsed well
- 2 eggs, at room temperature
- ¾ cup packed light brown sugar
- 5 tablespoons nonfat dry milk
- 3 tablespoons cornstarch
- ¾ teaspoon baking powder
- ¼ teaspoon kosher salt
- 6 tablespoons unsalted butter, at room temperature
- 2 teaspoons pure vanilla extract
- 4 ounces semi-sweet chocolate chips

Instructions:

1. Preheat your oven to 325°F. Line an 8 x 8-inch baking pan with unbleached parchment paper or nonstick aluminum foil and set it aside. In a blender or food processor, place the drained and rinsed beans and eggs, and blend until very smooth. Set the mixture aside.
2. In a large bowl, add the brown sugar, nonfat dry milk, cornstarch, baking powder, and salt, and whisk to combine, breaking up any lumps in the brown sugar.
3. To the large bowl, add the bean mixture, butter, and vanilla, and mix until it is very well combined. If necessary, whisk vigorously to smooth the mixture, which will be relatively thin.
4. Transfer the mixture to the prepared pan and scatter about half of the chocolate chips gently on top of the batter. They will sink a bit during baking but shouldn't fall all the way to the bottom.
5. Place the baking pan in the center of the preheated oven and bake for 15 minutes.
6. Open the oven door, gently pull out the rack with the pan on it, and scatter the remaining chocolate chips evenly on top of the blondies as they are baking. Return the rack with the pan on it to the oven, close the door, and continue baking for another 15 to 20 minutes, or until the top is lightly golden brown all over and the blondies spring back when pressed gently in the center.
7. Remove the pan from the oven and allow it to cool for at least 10 minutes before transferring the blondies, still in the paper or foil, to a wire rack to cool completely.
8. Slice into squares and serve. Store any leftovers in a tightly sealed container in the refrigerator for up to one week, or in the freezer for longer storage.

FUDGY FLOUR BROWNIES

Recipe taken from Inspired Taste: https://www.inspiredtaste.net/24412/cocoa-brownies-recipe/

Ingredients:

- 10 tablespoons unsalted butter
- 1¼ cups granulated sugar
- ¾ cup plus 2 tablespoons unsweetened cocoa powder, spooned and leveled
- 1 teaspoon vanilla extract
- ¼ teaspoon fine sea salt
- 2 large cold eggs
- ½ cup all-purpose flour, spooned and leveled
- ⅔ cup chopped walnuts, pecans, or chocolate chips, optional

Instructions:

1. Preheat oven and prep pan. Position an oven rack in the middle of the oven and heat to 325°F. Line the bottom and sides of an 8 x 8-inch baking pan with parchment paper or aluminum foil, leaving an overhang on opposite sides to help remove the baked brownies from the pan.
2. Add the butter to a medium saucepan. Place over medium-low heat and cook until the butter melts completely, then turn off the heat. Do not let it brown.
3. While the butter is hot, stir in the sugar, cocoa powder, vanilla, and salt. Stir well until blended. Don't worry if the batter looks gritty. Once you add the eggs later, the brownie batter will become smooth.
4. Set the saucepan aside to cool until the mixture is warm but not hot, 5 to 10 minutes. Test the temperature by touching the batter. It should still be quite warm, but not so hot that you need to pull away.
5. Add the cold eggs, one at a time, stirring vigorously after each egg.
6. When the batter looks thick and well blended, add the flour. Use a spoon to beat the flour into the batter until it is very thick and pulls away from the sides of the bowl. Inspired Taste suggests using a wooden spoon or spatula and beat for 40 to 50 strokes.
7. If using, stir in nuts or chocolate chips (optional).
8. Scrape the thick batter into your prepared pan and spread it evenly, pushing it into the corners. Bake for 20 to 30 minutes, or until the edges look set and the middle is slightly underbaked. A toothpick inserted into the center should come out with somewhat moist batter.
9. Let the brownies cool completely in the pan to ensure they set properly. To cut them, use a sharp chef's knife, wiping the blade clean after each slice for perfect edges. For even cleaner edges, chill the brownies in the fridge for 1 to 2 hours before slicing.

BROWNIE TASTE TEST

Name: _____

Kind of Brownie	Texture Observations	Flavor Observations	Aroma Observations	Appearance Observations	Would you make these again? Why or why not?	My Favorite *Rank 1 to 3*
Fudgy Black Bean						
White Bean Blondies						
Fudgy Flour						

MATCHING MAYHEM

For corresponding reading, check out Page 2 of More Than a Meal

HSE.HS.21.2.b | *Analyze farm to table for a variety of food products grown locally and globally.*

Supplies Needed:

- Matching Mayhem terminology cards, 1 set per group. (The terms and definitions should be cut apart. Ideally, print each group's set on a different color of cardstock.)

Directions:

1. Divide students into groups of two or three. Distribute a set of Matching Mayhem terminology cards to each group.
2. Allow students two minutes to match the terms with the correct definitions.
3. Check for accuracy as a class. Students can keep score of the number they got correct.
4. Discuss: Share a term you weren't familiar with prior to today.

MATCHING MAYHEM TERMINOLOGY CARDS

Sow	An adult, female pig that has given birth.
Wean	To separate piglets from their mother and transition them from liquid milk to solid food.
Brine	A mixture of water, salt, sugar, and curing ingredients.
Cure	A process using salt, sugar, and sometimes nitrites or nitrates to preserve and add flavor to pork.
Smoke	Exposing meat to smoke from wood (or natural smoke flavoring) to add flavor and color.
Wholesale	A business that stores and distributes products to retailers.
Retail	The final step in the food supply chain where products are sold to consumers.

UNDERSTANDING BACTERIA

Adapted from National Agriculture in the Classroom Curriculum Matrix

For corresponding reading, check out Page 3 of More Than a Meal

Supplies Needed:

- A hamburger, glass of orange juice, and a salad, option: Use pictures or food models
- Hot plate and skillet
- Food Safety Farm-to-Table Continuum illustration, 1 per student
- Dr. X and the Quest for Food Safety video https://www.youtube.com/watch?v=j8YfUEzBQ20 Module 1 — Understanding Bacteria (First 15 minutes of video)
- Background Information handout, 1 per student

For the Class:

- Dissecting microscope or hand lens to view microbial colonies
- Additional sterile Petri dishes with nutrient agar and covers for expanded tests
- Disinfecting solution to disinfect lab surfaces (20 mL of liquid household bleach in 1 L of tap water, see Safety First in the Lab handout)

For Each Team:

- 3 sterile Petri dishes with nutrient agar and covers
- 2 cups of sterile water
- Parafilm to seal the dishes
- Permanent marker
- Safety gloves
- Safety goggles
- Lab Report Outline for each student
- Bacteria Everywhere Data Table to record results

Advance Preparation

- Prepare or order three sterile Petri dishes containing nutrient agar for each team of three to four students. You may want to order extra dishes for students to test additional areas. Note: Petrifilm™ dishes can be used instead of Petri dishes. See Resources on page 95.
- Sterilize (boil) 500 mL of tap water for each team. You can boil the water in beakers and then cover with aluminum foil until ready to use. Students will use the water to wet swabs for testing dry surfaces.

Directions:

1. As students walk in, have a hamburger cooking to entice their senses. Other options are to post a large picture of the food in a conspicuous place, use food models, or dress up as a waiter/waitress. You can wear an apron and have a pad and a pen readily available for taking your students' "orders." As the students come in, let them comment on the food. Don't give them an explanation. Let the atmosphere stimulate their curiosity.
2. Ask, "What do you think the hamburger, orange juice, and salad have to do with science?"
3. List their answers on the board, then ask, "Which of these foods would you most like to eat? Is there anything that might be on the hamburger, in the orange juice, or in the salad that you didn't order?"

4. You may have to give them a few hints. Hopefully, someone will mention bacteria or germs. Then say, "Aha! You have your first clue to the connection between these foods and science!"
5. Now ask, "Has anyone you know ever become ill from eating food?" Encourage students to explain when, what, and where. How could you get sick from a hamburger, orange juice, or a salad? (You can get sick if harmful bacteria are present in the food. This is called "foodborne illness," sometimes referred to as "food poisoning.")

Activity 1

1. Ask students, "How many of you have been affected by foodborne illness?" Write that number on the board.
2. Now compute the percentage of the class who think they've had foodborne illness.
3. Using that percentage, ask the class to estimate the number of students in the entire school who might have had foodborne illness. *Note: Tell the students that this is only an assumption and not an actual survey. This information is simply being discussed to help the students relate to the statistics that you are about to give them.*
4. Present this information on the board:
   a. Foodborne Illness in the United States (2010 estimates):
      - 48 million illnesses
      - 128,000 hospitalizations
      - 3,000 deaths *Centers for Disease Control and Prevention*

   b. As of February 2026, there were approximately 342.7 million people in America. [For the latest population count, refer to the U.S. Census Bureau population clock]. Ask the students to calculate the percentage of the UnitedStates population that would be affected if 48 million people were to become sick due to foodborne illness. Discuss the students' reactions to this percentage and have them relate it to the percentage calculated for the class. Then, reiterate the importance of studying food safety to prevent foodborne illness.
5. Let the students form the following three teams — hamburger, orange juice, and salad. Then ask, "How do you think the hamburger, orange juice, or salad got to you?" Let them brainstorm for about 10 minutes and have them list their ideas. This exercise provides the segue for introducing the Farm-to-Table Continuum.
6. Show students the Food Safety Farm-to-Table Continuum illustration. Let them cross-check their lists with the Continuum. Tell them that they may include even more steps, and that's good!
7. Now ask, "Whose responsibility is it to keep this hamburger, orange juice, and salad safe from harmful bacteria?" Hopefully, the students will conclude that it's everyone's responsibility, including their own, once the food is in their possession. Discuss the reasons we all play a role in protecting our food supply.
8. Next you will show a short video clip. Introduce the video by explaining: "There's a lot of science behind keeping our food safe. Throughout this lesson, you'll become a food scientist and conduct labs and research projects. Let's begin by meeting Dr. X, a crusading food scientist who has dedicated his life to fighting harmful bacteria and foodborne illness; and Tracy, a student who is working on her science video project and teams up with him on his mission. I challenge you to uncover the following food safety/science links as you watch the video."
   - What four weapons does Dr. X use to fight harmful bacteria?
   - What is the significance of the mysterious O157:H7?
   - What is Dr. X referring to when he talks about the "baddest of the bad"?
   - What does DNA have to do with bacteria? What does it tell us?
   - Tell the students: You'll be conducting labs and doing further research on many of the things you'll see in the video, so pay close attention!
9. Show Dr. X and the Quest for Food Safety video. https://www.youtube.com/watch?v=j8YfUEzBQ20 Module 1 — Understanding Bacteria (First 15 minutes of video)
10. Discuss the video using the questions presented prior to the video.

Activity 2

WHAT IS A CONTROL DISH?

In this lab, the purpose of the control dish is to determine whether or not the dish, agar, swab, or any other associated swab materials are contaminated with bacteria. If after incubation there are colonies growing on the control dish, one or more of the listed materials were contaminated. The control dish can also be called the control plate.

TIPS

This lesson involves the following three steps in gathering information:

1. Isolate the sample.
2. View the sealed dishes under a dissecting microscope or a hand magnifier.
3. Consider the number of colonies and the diversity of the colonies.

1. As students walk into the classroom, peer through a large magnifying glass in search of bacteria in various sections of the classroom. Your students will wonder what you're doing. Explain to them, "You're going on a microorganism safari, and during this safari you're going to become science detectives. Your assignment is to find areas where bacteria are living and come up with a plan to determine which areas have the most and least bacteria."
2. Get the students started by asking, "Are there bacteria in this classroom? Where? Where else might they be living around the school?" Make a list of the responses. Some probable answers include soda machines, doorknobs, desks, trash cans, door handles, water fountains, faucet handles, bathroom stall doors, toilet seats and flush handles, biofilm in sink drains, paper towel dispenser handle, lab tables, and counters. Allow the students to mention things at home, but tell them, "For today, let's investigate bacteria here at school." If they haven't mentioned their hands, under fingernails, etc., ask, "What about you? Could bacteria be on you?" Now ask, "What do bacteria look like? (Let them discuss this.) Can you see them? If you can't see them, how can you say that bacteria really exist? This leads us into today's lab. We're going to design labs that allow us to see bacteria."
3. Have students work in teams of three to four. Ask each team to select a team name and then choose at least four to six areas of the classroom or school to examine. Have the students try for as many different areas as possible, but make sure the important areas, such as hands and/or under the fingernails, are tested by at least two teams. (If students are searching for bacteria on their hands or under their fingernails, they should wash their hands after they swab those areas.)
4. Now have each team hypothesize about which areas will have the most bacteria. Which will have the least bacteria? Why? How fast will the bacteria grow? Why?
5. Have each team design a lab to test its hypothesis.
6. Let each team present its hypothesis and lab design to the class. Encourage students to discuss the merits of each suggested test. This is also an important time for guided inquiry. For example, you can guide them by asking a question such as: How can you be sure that your agar isn't contaminated? (You should always have a control dish.) After the group discussions, give teams time to revise their hypotheses and lab designs.
7. Show students how to swab a surface (on dry surfaces use a moist swab) and inoculate a Petri dish (see second page of the attached Safety First in the Lab handout).
8. Review the important rules of lab safety, especially the handling of bacteria in Petri dishes (see page 1 of the Safety First in the Lab handout).
9. Give each team three Petri dishes. Ask them, "Is there anything you should do with these dishes before you start your lab?" Have the students:
   - Label the dishes on the bottom (agar side).
   - Divide the control dish into thirds. Label the control dish: agar, wet swab, and dry swab. Then, swab the control dish.
   - Divide and label the other two dishes with the areas they want to test.
   - Label the dishes with the date, team name, class, and hour to avoid mix-ups. Remind them to label along the side, so that they'll be able to see the bacterial growth in the center.

- For easy and fun identification, students can swab the dishes using their initials.

10. Give the students 10 to 15 minutes to gather their samples and inoculate their dishes.
    - Seal Petri dishes closed with Parafilm.
    - Place dishes in an incubator at 35°C (95°F) or let the dishes sit at room temperature for the appropriate amount of time.
    - Ask students to set up time parameters — the number of hours or days they think it will take for the bacteria to grow.
11. Have students observe the bacterial growth and record the results. Students can use the Bacteria Everywhere Data Table to record their results. *Tip: Ask the students to draw their Petri dishes on the back of the Data Table and illustrate the colonies that are growing.*
12. Students can analyze the results based on their observations. Ask them:
    - "What do you see?" (Their first observation may be the number of bacterial colonies. If so, use a 0–5 scale for rating the quantity. Guide students in ranking the results.)
    - "What else do you notice about the colonies?" (Their next observation may be the size and shape of the colonies.)
    - "Why do they look different?" (Different colonies/microorganisms have different characteristics.)
13. Have each team report the following to the class: the areas they sampled, the number of colonies they observed, and the characteristics (size, shape, and color) of the colonies.
14. Ask students, "Were there any differences in your results compared to the other teams? How did your results support or reject your hypothesis?"
15. "Are the colonies composed of good or harmful organisms?" (With this lab, students will not be able to identify good versus harmful organisms. They would need specific agars to grow and identify specific organisms. The purpose of the lab is to demonstrate that bacteria are everywhere and different surfaces have different levels of organisms. Also, stress that not all bacteria are harmful. In fact, most bacteria are beneficial to us.)
16. Be sure to properly dispose of the Petri dishes as outlined in the Safety First in the Lab handout.
17. Ask students to write a lab report (see the Lab Report Outline).

Application to Food Safety

1. How can bacteria transfer from objects to foods, from people to foods, and from foods to other foods? (By contact with contaminated objects, hands, and food.)
2. Which of the 4 Cs applies to the data you've collected? (Clean and Combat Cross-Contamination)
3. Why is it important to thoroughly clean some surfaces more than others? (Bacteria thrive in some areas more than others because some areas may have more opportunities for contamination and for growth; for example, if the area is damp rather than dry or is more likely to be exposed to raw foods.)
4. What are your suggestions for cleaning surfaces during food preparation? (Allow student suggestions.)
5. Based on your findings, what advice would you give to people who prepare food (restaurant workers, cafeteria workers, etc.) to help prevent the spread of harmful bacteria? (Clean surfaces thoroughly, wash hands properly, and don't cross-contaminate surfaces and foods.)

Everyone Plays a Role in Reducing Foodborne Bacteria!

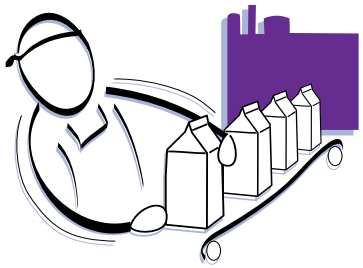
FARM

Use **Good Agricultural Practices**

TABLE

Always Follow the **4 Cs of Food Safety**

- Clean
- Cook
- Combat Cross-Contamination
- Chill



PROCESSING

Monitor at **Critical Control Points**

RETAIL

Follow the **Food Code** Guidelines

TRANSPORTATION

Use Clean Vehicles and Maintain the **Cold Chain**

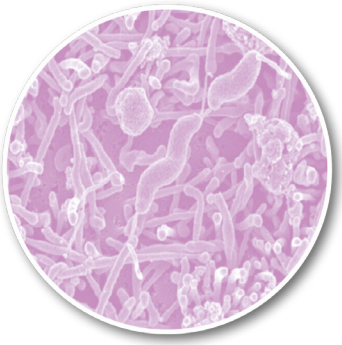
FOOD SAFETY FROM FARM TO TABLE

www.fda.gov/food

www.nsta.org

Background Information

Food safety is everyone's responsibility — everyone involved in growing, processing, transporting, and handling food at every point in our complex food production and distribution system. This responsibility includes all of us as we purchase, prepare, and eat our food. Food safety is a very serious issue that affects the well-being of every individual. So, because everyone must eat, we're all at risk of becoming ill if food becomes contaminated.



Magnified image of *Campylobacter jejuni*

Lan Hu, Ph.D., Dennis J. Kopecko, Ph.D., and Ben Tall, Ph.D.

Food Safety and the Battle with Bacteria

The United States has one of the safest food supplies in the world, but there's always room for improvement. The battle to prevent foodborne illness is waged every day because bacteria are everywhere. Food safety has to do with controlling bacteria. And since everyone eats, we all share the responsibility for keeping our food free from harmful bacteria.

Electron Microscope

An electron microscope uses electrons instead of visible light to produce magnified images. It can magnify bacteria a million times their normal size.

Where Bacteria Come from and How They Grow

Bacteria are found everywhere, and under the right conditions, they can multiply fast! Each bacterium contains all the genetic information needed to make copies of itself. Bacteria multiply through binary fission, a process in which the cell's DNA doubles, the cell splits, and two independent cells are formed. Under the right conditions, a single bacterium will double with each division — two become four, four become eight, etc. A single cell can turn into millions of cells in a few hours and billions of cells within one day!

Bacteria multiplying

James A. Sullivan/ Cells Alive

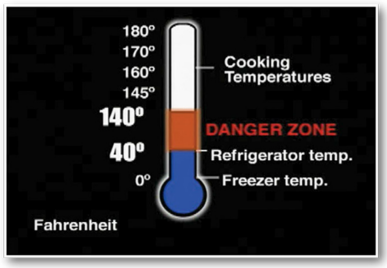
This rapid growth is not usually a problem with good bacteria; however, when it occurs with bad bacteria (a.k.a. pathogens), it is bad news. As pathogens multiply, some give off harmful toxins or become infectious. If pathogens get into our food and multiply, people can get sick.

The 12 Most Unwanted Bacteria

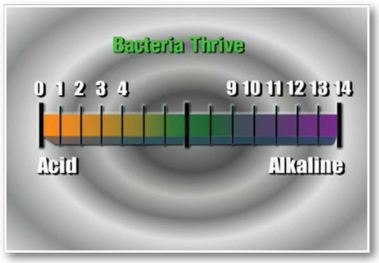
- Campylobacter jejuni
- Clostridium botulinum
- Clostridium perfringens
- Escherichia coli O157:H7
- Listeria monocytogenes
- Salmonella Enteritidis
- Salmonella Typhimurium
- Shigella
- Staphylococcus aureus
- Vibrio cholerae
- Vibrio vulnificus
- Yersinia enterocolitica

Required Conditions for Bacterial Growth

- Time/Temperature — Under the right conditions, some bacteria can double their numbers within minutes and form toxins that cause illness within hours. To minimize bacterial growth in foods, it's important to keep food temperatures below 40°F (4° C) or above 140°F (60° C). The level in between this temperature range is known as the Danger Zone.



Danger Zone



pH level

- Nutrients — Bacteria need many of the same nutrients as humans to thrive (glucose, amino acids, and some vitamins and minerals). For example, bacteria grow rapidly in high-protein foods such as meat, poultry, eggs, dairy, and seafood.
- pH — Microorganisms thrive in a pH range above 4.6. That's why acidic foods like vinegar and citrus do not provide favorable conditions for pathogenic bacteria to grow; however, these bacteria still may survive in these foods.
- Moisture — Most bacteria thrive in moist environments; they don't grow on dry foods. That's why dry foods like cereals can safely sit out at room temperature.

- Note: If dry foods like dry cereals or spices become contaminated from infected hands or equipment, bacteria can survive on the food and make people sick, but they can't grow or multiply until the food is consumed.

How the 4 Cs of Food Safety Control Bacteria

If bacteria can grow so rapidly under the right conditions, then how do we control them? It's simple:

- Cleaning — removes bacteria from hands and surfaces.
- Cooking — kills bacteria by breaking down their cell walls and destroying enzymes, which they need to survive.
- Chilling — slows down the bacteria's metabolism, thus slowing their growth.
- Combating Cross-Contamination (separating foods) — prevents bacteria from spreading from one food item to another, or between foods and hands or surfaces/utensils.

The 4 Cs of Food Safety

Emerging Pathogens

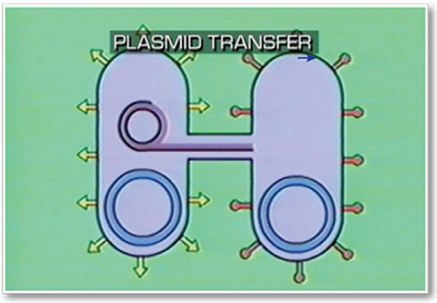
Not only can bacteria multiply quickly, but they can also mutate (adapt and evolve), a process that results in changes to their genetic code. These changes happen very slowly and can make the bacteria better able to survive. These adaptations can also change harmless bacteria into harmful bacteria, which often possess a new genetic characteristic like antibiotic resistance.

How Scientists Can Tell Good Bacteria from Harmful Bacteria

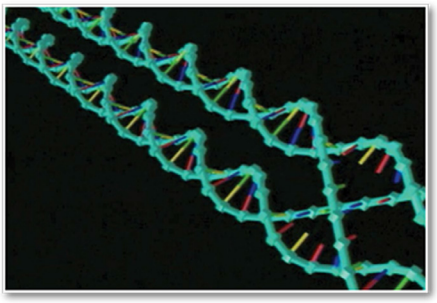
DNA (deoxyribonucleic acid) is the genetic blueprint for all living things. A DNA molecule looks like a double helix that's shaped like a long ladder twisted into a spiral. The ends are joined to form a continuous loop, like a rubber band.

DNA contains the information that gives living organisms their traits or characteristics. In people, it determines traits like physical features, behaviors, and even whether we're right or left-handed. In bacteria, the DNA molecule encodes the information that enables bacteria to grow, reproduce, and cause illness.

Scientists use DNA fingerprinting to identify similar groups of bacteria. DNA is treated with laboratory techniques to produce a distinctive pattern, or fingerprint. When there is an outbreak of foodborne illness, epidemiologists (scientists who track down the causes of diseases and find ways to control them) try to determine the source of bacteria in foods by examining the pathogen's DNA fingerprint. Then they see if it matches fingerprints (patterns) from other samples.



Bacteria mutating
Howard Hughes Medical Institute



DNA molecules
James A. Sullivan/ Cells Alive

Food Safety Connection

Food safety is everyone's responsibility — everyone involved in growing, processing, transporting, and handling food at every point in our complex food production and distribution system. This responsibility includes all of us as we purchase, prepare, and eat our food. Students need to understand that food safety is a very serious issue that affects the well-being of every individual. So, because everyone must eat, we're all at risk of becoming ill if food becomes contaminated.

SAFETY FIRST IN THE LAB

Preparing for the Lab

- Wash your hands with hot, soapy water. If soap and water are not available, you can use disposable wipes or a gel hand sanitizer.
- Wear disposable safety (protective) gloves.
- Tie back long hair.
- Wear safety goggles or regular glasses for microbiology work.
- If possible, wear a lab coat or apron.
- NEVER EAT, DRINK, OR CHEW GUM IN THE LAB. Keep your hands, pencils, etc. out of your mouth.
- Disinfect all surfaces with a disinfecting bleach solution before beginning a lab (see box above).
- INAPPROPRIATE BEHAVIOR WILL NOT BE TOLERATED AT ANY TIME IN THE LAB!

TIP **Disinfecting Bleach Solution:** 20 ml of liquid household bleach (chlorine bleach) in 1 L of tap water.

Safety Gloves

- Wear safety gloves when inoculating Petri dishes and when working with raw meat.

  Safety gloves are made using many types of materials, including vinyl and polyethylene. They can be purchased at a local pharmacy, supermarket, or through science supply catalogues.
- When removing safety gloves, be careful not to contaminate your hands, items, or surfaces with any residue that may be on the gloves.
- Throw away used gloves immediately after removing them. Wrap one glove inside the other, then throw both gloves away.
- Wash your hands with hot, soapy water after removing the gloves.

Hot Surfaces

- Use thermal gloves or hot-pad holders when working with hot plates, burners, autoclaves, or any other heat source.

Petri Dishes

- Use Parafilm to seal Petri dishes after inoculating them.
- Never open a Petri dish with organisms growing in it. It could contain/release dangerous pathogens!

Pipettes

- ***Never pipette by mouth.*** Always use a pipette bulb or pipette aid.
- Be careful when attaching a pipette bulb. Hold your hand close to the end of the pipette where the bulb will be attached. Push the bulb onto the pipette carefully and gently. If you push too hard, the pipette could break and you could cut yourself.

Food in the Lab

- NEVER EAT OR DRINK ANY FOOD OR LIQUID USED IN A LAB.
- Thoroughly wash hands before and after handling and cooking raw meat.
- Wear safety gloves and lab aprons when handling raw meat, as well as safety goggles when cooking raw meat.

Proper Clean-Up

- Wear safety gloves and take appropriate defensive measures when cleaning up cultures and used equipment.
- Wash all glassware and other instruments in hot, soapy water, then sterilize them (see page 8).
- Properly dispose of used Petri dishes and other used equipment.
- Thoroughly disinfect all surfaces, especially those that were in contact with raw meat.
- Before leaving the lab, wash your hands with hot, soapy water or use a gel hand sanitizer.

Disposal of Used Materials and Equipment

- Check your school, local, or state safety regulations for specific information on how to properly dispose of potentially hazardous materials. If there are no guidelines, follow these precautions:

For Raw Meat

- Unless contaminated with a virulent pathogen in the lab, raw meat and other foods can usually be disposed of as regular solid waste. Place the meat in a sturdy plastic bag, seal, and dispose.

For Used Swabs, Petri Dishes, Pipettes, and Other Disposable Equipment

- Use a sturdy plastic bag that won't leak.
- Place the bag in a metal container, such as an empty coffee can. Use one bag/container for each team of students conducting the labs.
- Place used swabs, disposable Petri dishes, pipettes, etc. in the bag.
- At the end of the lab, add enough disinfecting bleach solution (see above) to cover the contents and tightly close the bag.
- Dispose of the closed bag in the trash.

Note: Equipment that will be reused should be cleaned using hot water and soap and then placed in boiling water for 10 minutes or sterilized in an autoclave.

LAB REPORT OUTLINE

Name _____ Date _____ Class/Hour _____

(Write in complete sentences. Measure in metric.)

1. Problem *(What question are you investigating?)*	
2. Hypothesis *(What do you think will happen?)*	
3. Materials *(List the supplies needed to conduct the lab.)*	
4. Procedure *(List the steps followed to complete the lab.)*	
5. Results — Your Data *(What did you see, hear, or smell? Use a graph, chart, and/or illustration to describe.)*	
6. Conclusion *(Explain the results using the appropriate vocabulary. Do your results support your hypothesis?)*	
7. Further Questions *(Based on the results and conclusions from this lab, what other questions would you like to explore?)*	

BACTERIA EVERYWHERE

DATA TABLE

Name_____ Date_____ Class/Hour _____

LAB 1 — Find the Bacteria		LAB 2 — Observe and Record the Results	
Choose the Areas to Be Examined	Hypothesize the Least/Most Abundant Areas	Rank the Amount of Colonies 5 (most) 0 (least)	Describe the Size, Shape, and Colors of Colonies

PROTEIN MATH: HOW MUCH DO I NEED?

For corresponding reading, check out Page 4 of More Than a Meal

HSE.HE.31.I.b | *Explain current dietary recommendations.*

Supplies Needed:

- Protein Math worksheet, 1 per student.

Directions:

1. Engage students by asking, "What's one food you've eaten today?" Make a master list on the whiteboard as students share.
2. Using page 4 of More Than a Meal for supported reading, see if students can identify which nutrient these foods are a major provider of. Write the nutrient next to the food on the board as students discuss. For example:
   - Cheese – Protein and Fat
   - Hamburger – Protein and Iron
   - Eggs – Protein and Fat
   - Green beans – Fiber
   - Orange juice – Carbohydrates (Sugar)
3. Share with students that there are three macronutrients, the essential nutrients your body needs in large quantities to produce energy, maintain tissue structure, and support overall bodily functions: carbohydrates, protein, and fat. Ask students to evaluate the foods they've eaten today. Have they consumed macronutrients?

   Let's focus on one macronutrient: protein. In the updated Dietary Guidelines for Americans, put out by the USDA, protein intake is recommended to be 1.2-1.6 g protein per kg of weight. (For example, a 150 lb (68 kg) person needs approximately 95 g of protein per day.) This nearly doubles the old recommendation. So, let's see how much protein you need specifically!
4. Use the worksheet, Protein Math, to guide students to determine their personal protein recommendation.

PROTEIN MATH: HOW MUCH DO I NEED?

Name: _____

1. Convert your weight in pounds (lb) to kilograms (kg) by multiplying your weight by .45.

   _____ (lb) x .45 = _____ (kg)

2. Take your weight in kg and multiply it by 1.4.

   _____ (kg) x 1.4 = _____ grams of recommended protein/day

**This is general advice. Your personal protein recommendations are best determined by your healthcare provider.*

3. What are some foods you currently eat that are a good source of protein?

   _____

4. What foods could you add to your diet to increase your daily protein consumption?

   _____

5. Why is protein necessary in the body?

   _____

PROCESSED FOOD BREAKDOWN

For corresponding reading, check out Pages 4-5 of More Than a Meal Adapted from National Agriculture in the Classroom Curriculum Matrix

HSE.HS.21.4.d | *Identify package labeling components.*
HSE.HS.21.4.e | *Analyze the Nutrition Facts label to determine nutrient contributions of a variety of foods.*

Supplies Needed:

- 5 canned food items
- 5 frozen food items (or frozen food packaging), including frozen fruit or vegetables
- 5 boxed meals, including a cereal option
- 5 drinks
- 5 packaged baked goods/other packaged foods
- Any other processed food items deemed necessary
- Processed Food Breakdown worksheet, 1 per group

Directions:

1. Place food items listed in the Supplies Needed section on five tables according to their category.
2. Divide students into teams of three to four.
3. Pass out one Processed Food Breakdown worksheet to each group. Explain that each team will be competing to create the healthiest meal out of the processed food items on the tables. Each meal must include at least one item from four of the five tables. On the worksheet, students will record the vital information about each item they choose and an explanation justifying why they think their meal is the healthiest.
4. Allow students 5 to 10 minutes to read labels, explore the food items, and make their selections.
5. After they have selected their food and filled out their worksheet, group members should prepare a short (2 to 3 minute) presentation explaining the nutritional content of their meal.
6. As each group presents, lead a class discussion using questions such as:
   a. Where on a food label or nutrition label should you look for the nutritional value of a food item?
      The Nutrition Facts label contains important information such as serving size, calories, fat content, percent daily value, etc.
   b. What are some foods that might be healthier than the ones offered on the tables? Why?
      In some cases, fresh, whole foods may have improved nutrient value, such as lower levels of sodium, sugar, and fat, or fewer calories. However, each food is different and needs to be analyzed separately. Some processed foods contain more nutritional qualities if they have been fortified with vitamins or minerals.
   c. Were these foods processed? What is a processed food?
      Yes, these foods are processed. In general, processed foods are in a different form than they were when they left the farm where they were produced. Examples include various forms of preservation and packaging such as freezing, canning, or dehydrating. Processed foods can also be cooked, mixed, or prepared in some way, such as turning wheat into pasta or bread.
   d. Is there any additional information on the label that could impact a consumer's buying choices?
      Aside from nutritional information, packaging and labels may also indicate specifications followed in the production of the food on the farm. Examples include USDA Organic, all natural, grass-fed, cage-free, and hormone- or antibiotic-free. These labels indicate specific production practices were used on the farm and may impact the decision of some consumers.
   e. If you hadn't been instructed to choose only healthy foods, how would your choices have differed?
   f. Are all processed foods bad?
      No.

Name(s):_____

Processed Food Breakdown

1. Select the healthiest food from 4 of the following categories:
   - Drinks
   - Boxed foods
   - Canned foods
   - Prepackaged foods
   - Drinks
2. For each food, record the important nutrient information in the boxes below.
3. Once you have selected all of your food items, write a persuasive statement as to why you have created the healthies meal.

Food item: Serving size & calories: First 3 ingredients: Other deciding factors:	Food item: Serving size & calories: First 3 ingredients: Other deciding factors:
Food item: Serving size & calories: First 3 ingredients: Other deciding factors:	Food item: Serving size & calories: First 3 ingredients: Other deciding factors:

4. Write a persuasive statement to the following question:

Why do you have the healthiest meal?

CHOCOLATE CHOICES: HOW DO YOU DECIDE?

For corresponding reading, check out Page 6 of More Than a Meal

Adapted from National Agriculture in the Classroom Curriculum Matrix

HSE.HS.32.6.a | *Explain the biological, social, psychological, economic, political, and/or cultural influences on individual and community nutrition practices.*
HSE.HS.19.7.b | *Compare and contrast flavor, texture, aroma, and appearance of various foods.*

Supplies Needed:

- 4 types of milk chocolate bars (small sample for each student)
- 4 types of dark chocolate bars (small sample for each student)
- Paper plates (dispenser for milk chocolate samples and dark chocolate samples)
- Chocolate Taste-Testing worksheet, 1 per student

Directions:

1. Obtain enough milk chocolate and dark chocolate for each student to sample a small piece of each kind of bar. Keep the chocolate bar wrappers. You may need these later to determine cocoa or sugar content, or to view nutritional data.
2. Open bars and use a knife to scrape off any identifying logo or words (e.g., Hershey). Cut samples (a half-inch square from each bar is enough) from large bars.
3. Use a marker to draw four quadrants on each paper plate. Label one quadrant M1 (for milk chocolate sample one), M2 (for milk chocolate sample two), M3 (for milk chocolate sample three), and M4 (for milk chocolate sample four). Mark the second plate in the same manner but label the quadrants D1, D2, D3, and D4.
4. Use your receipt to calculate the price per ounce for each chocolate sample.
5. Review the Chocolate Taste-Testing worksheet with students, explaining that they should use it to take notes as they sample the different types of chocolate. As students taste test, encourage them to do so silently because others' perceptions can impact their taste analysis, and we want this to be as unbiased as possible.
6. Ask students to begin tasting. You may want to have cups of water for students to drink between samples.
7. After all students have sampled all of the chocolates, share the names, ingredients, and costs of the chocolate bars with students, and ask them to complete their worksheets.

Sample Chocolate Cost Calculations

Milk Chocolate	Bar Size	Price	Price/Oz
M1 Lindt Milk	4.4 oz	$2.00	$0.45/oz
M2 Symphony	4.25 oz	$1.25	$0.29/oz
M3 Hershey's Milk	4.4 oz	$1.25	$0.28/oz
M4 Ghiradelli	3.0 oz	$1.98	$0.66/oz

Dark Chocolate	Bar Size	Price	Price/Oz
D1 Hershey's Special Dark	4.4 oz	$1.25	$0.29/oz
D2 Ghiradelli Twilight	3.5 oz	$2.28	$0.65/oz
D3 Lindt Dark	4.4 oz	$2.00	$0.45/oz
D4 Costa Rica	3.5 oz	$2.28	$0.65/oz

8. Explain to students that the ingredient list notes what is in the chocolate from largest to smallest quantity. If sugar is before cocoa that means the chocolate has more sugar. The chocolates' ingredients determine taste and texture. Use the following questions to explore students' observations:
   a. Does the chocolate have a waxy texture?
   b. Does it cost more or less compared to the other chocolates?
   c. Does chocolate with a strong chocolate flavor cost more?
   d. Do you like sweeter chocolate?
   e. What costs more — chocolate with more sugar or chocolate with more cocoa?
   f. Do you prefer dark chocolate or milk chocolate?
9. Have students analyze their chocolate rankings based on taste. Ask, "If you had seen the labels and prices first, would your rankings be different? How do you most often make food purchasing decisions? How might people of different cultures/backgrounds make decisions differently or similarly to you?"

MANAGING WATER

Adapted from National Agriculture in the Classroom Curriculum Matrix

HSE.HS.21.2.c | *Identify issues surrounding global production of food and how sustainability and conservation practices are connected.*

Supplies Needed:

- One-gallon container, clear bowl, ½-cup measuring cup, eyedropper
- Water slide deck - click "Make a Copy", use slides 1-15, https://docs.google.com/presentation/d/1csF1T0x1B0IT88eHeHFSvoNOqoc_4fy_/copy?usp=sharing&ouid=102282951093749318876&rtpof=true&sd=true
- Journey 2050: Water video: https://www.youtube.com/watch?v=bI7hYAomzGk
- Variable rate irrigation lab handout, 1 per student
- Variable rate irrigation video: Precision VRI: Make Every Drop Count. https://www.youtube.com/watch?v=qxW2B0NGwEY

For each lab group:

- Water bottle (16 oz)
- 1 styrofoam cup
- 3 plastic cups
- Variety of straws (jumbo, regular, coffee)

Directions:

1. Fill a one-gallon container (such as a plastic ice cream bucket) with water. This represents all the water on Earth.
2. Pour one half-cup of water out of the one-gallon container and into a clear bowl. The water in the bowl represents all of the freshwater on Earth, which is less than 3% of the planet's total water. Freshwater is found in lakes, rivers, groundwater, ice, and living things. The 15 half-cups that are still in the one-gallon container represent salt water. We cannot use salt water without first removing the salt in a process known as desalination. Though research and technology are improving this process, it is still prohibitively expensive and often impractical.
3. With an eyedropper, place one drop of water from the half-cup onto a small plate. This one drop represents the freshwater that is available for our use. This water is found in rivers and lakes. Explain that the rest of the water in the half-cup is deep groundwater, water bound up as soil moisture, water in living things, or water in the atmosphere.
4. Share the following statistics:
   - Over 70% of Earth is covered in water, but only a small amount is freshwater.
   - Only 2.5% of all the water on Earth is freshwater.
   - Only a small amount of the freshwater on the Earth is easily accessible because the rest is found in groundwater, the atmosphere, glaciers, and ice caps.
   - Groundwater is the easiest to access and makes up about 30%, but that still leaves us with over 68% of fresh water found in icecaps and glaciers making it inaccessible. Only about 0.3% of our freshwater is found in the surface water of lakes, rivers, and swamps.
5. Help students conclude from the demonstration that water is a limited natural resource. Ask, "How are water and agriculture related?" Use further guiding questions until students recognize that farmers must use a portion of our water supply to grow the crops and raise the livestock that provide our food supply. Ask students, "What practices can farmers use to conserve and protect freshwater?" Inform students that they will be learning about how water use in agriculture can be managed to provide food more sustainably for our growing population.

Activity 1

1. Open the water slide deck. Play the Journey 2050: Water video (5:07). Engage students with the video by asking them to discover three things:
   - 1. How is water used in agriculture?
   - 2. What methods do farmers use to irrigate their crops?
   - 3. What best practices can be implemented to use water more efficiently in agriculture? (Background and discussion prompts are outlined in the steps below and in the PowerPoint notes).
2. How is water used in agriculture?
   - Slide 4: Ask students, "What do farmers need to grow a crop?" Use the click animations on the slide deck to display open space, fertile soil, sunshine, correct climate, and seeds. Once these items have been discussed, explain that there is one more item. Without it, the crop will fail completely. Ask students what this could be. (Water)
   - What methods do farmers use to irrigate their crops? Describe these common methods:
   - Slide 7: Drip Irrigation — Using the picture, describe drip irrigation. Water is sent through plastic pipes that are laid along the crop rows. Tiny holes allow water to drip out at the base of the plants. This method is most effective for fruit and vegetable crops.
   - Slide 8: Center-Pivot Irrigation — Using the picture, describe center-pivot irrigation. This is a large sprinkling system on wheels. A line of sprinklers pivots around a center point in a field. This method creates the green crop circles that can be seen from a plane.
   - Slide 9: Flood/Furrow Irrigation — Using the picture, describe flood or furrow irrigation. To utilize this method of irrigation, farmers dig furrows between their crop rows. Water is delivered to the top of each row using ditches or siphon hoses. The crop is irrigated as the water flows from the top to the bottom of each row.
   - Slide 10: Ask students, "Besides irrigation, what other ways do farmers use water?" Allow students to offer their answers. Guide the discussion, clarifying that irrigation accounts for most of the water use in agriculture, but water is also needed to raise livestock and to clean and sterilize facilities, such as milk barns or food processing plants, in order to prevent foodborne illness.
3. What best practices can be implemented to use water most efficiently in agriculture?
   - Ask for ideas of how farmers can conserve water as they grow our food and fiber.
   - Slide 12: Refer back to the video clip they viewed at the beginning of the lesson. It described a practice called conservation tillage. Explain that farmers will leave crop residue (materials such as stalks, stems, and seeds) in their fields without plowing it under in the fall. In the spring, they use an air seeder (a device that precisely plants the seeds at equal distances and proper depth in the soil and then covers them) to plant the next crop, eliminating the need to plow the soil. Conservation tillage improves water-use efficiency in crops.
   - Slide 13: Explain that a riparian area is a space between land and a waterway, ideally filled with native grasses, shrubs, and trees. Landowners can improve water quality by preserving wetland and riparian areas, which have many benefits. These areas help filter nutrients that are collected as water runs over the land; help control water levels during floods; and provide habitat for animals. If possible, use a local riparian area as an example to help students understand.
   - Slide 14: Explain to students that some methods of irrigation are more efficient than others. Best practices in irrigation vary by farm and crop, but they will generally enable farmers to decrease water evaporation, deliver water more directly to plant roots (eliminating water loss to other locations or from runoff), and measure precise soil moisture for exact watering.
   - Slide 15: Ask students, "How can we protect and conserve water at home and in our schools and communities?" As students discuss answers, reinforce the concept that our actions affect our natural resources. Water conservation ideas include: turning off the water while brushing your teeth, using low-flow toilets, using water bottles and refill stations, decreasing shower times, etc.
   - Explain to students that they will be developing a model of one irrigation method that can manage water.

Activity 2

Precision agriculture is a farm management concept based on observing, measuring, and responding to inter- and intra-field variability in crops. Variable rate irrigation is a type of precision agriculture that involves applying water at a variable rate along the center pivot rather than one uniform rate along the entire length of the system. Variable rate irrigation applies water at different rates based on wet areas, soil types, and overlapping pivots.

Variable rate irrigation is made possible using GPS, a field computer, a rate controller, telematics, and a meter. GPS is used by farmers to create field maps that show a field's boundaries. Field computers allow farmers to control the application of water, fertilizers, herbicides, and pesticides through automated delivery systems. Farmers can monitor yields and moisture using computers. Rate controllers make it possible for farmers to control how much water, fertilizer, etc. are applied in a field. Telematics allows information collected in a field to be transferred through the internet.

Water use efficiency is calculated by determining the difference between irrigated yield and dryland yield and dividing that by the irrigation in inches. By performing these calculations, farmers will discover how much they should irrigate a section to increase yields and save water.

1. To explain and illustrate the detailed technology that can be used to manage irrigation systems, show the video clip, Precision VRI: Make Every Drop Count. https://www.youtube.com/watch?v=qxW2B0NGwEY

   Discuss: Why would farmers want to use variable rate irrigation?
   - To increase crop yields. Too much or too little water decreases plant health and crop yield.
   - To conserve water.
   - To provide precise watering for each soil type and slope within a field. (Soil type can vary within a field. Clay soil holds high amounts of water, which allows the roots to soak in the water for a longer time. In sandy soil, water can quickly run through the soil without penetrating the roots).
2. Guide students through the instructions for the variable rate irrigation activity in the student handout. Explain to students that they will build a device to vary water flow (just like in variable rate irrigation). Their goal is to build a system to divide 16 oz of water into three cups, with: 2 oz in one cup, 6 oz in another cup, and 8 oz in the third cup.
3. Place students into groups of three. Distribute a 16 oz water bottle, three cups, scissors, and a choice of straws or other materials to each group.
4. Prior to allowing students to create their systems, discuss the engineering design process with students and have them complete the first page of the handout.
5. Give students 10 minutes to construct a device to simultaneously divide the water into three different amounts. Allow students to test their design and share it with the class.
6. After their designs have been tested, instruct students to complete the last page of their handout.
7. Encourage students to reflect on the activity through class discussion by asking the following questions:
   - Was your design successful?
   - What could you do to improve your design?
   - What career could you choose that uses these skills to develop instruments used in precision agriculture?
   - Why is precision agriculture important?
8. Summarize the lesson with the following key points:
   - Technology has developed and improved over time. It helps farmers and ranchers provide more food to more people.
   - Using technology in agriculture decreases negative environmental impacts in our world.

TEACHER NOTES: VARIABLE RATE IRRIGATION (VRI) LAB

Goal

Divide water into amounts of 2 fl oz,6 fl oz and 8 fl oz

Instructions

- Form groups of 3-4 people
- Each group will receive:

16 oz. Water Bottle

Styrofoam Cup

3 Plastic Cups

Pair of Scissors

Available Supplies – Choose 2

Coffee Straws

Regular Straws

Jumbo Straws

Pipe cleaners

Increasing Production with Precision Agriculture (continued)

Part 2: Designing a VRI System

Problem and Objective

Ex. Need to construct a device to vary water flow

Brainstorming

Ex. Differences in straw diameters will play a factor

Constraints and Criteria

Ex. Allowed to use only 2 materials (limited resources)

Testing

Ex. Water flowed into amounts of 5 fl oz, 5 fl oz, 6 fl oz

Potential Solutions

Ex. Need to use different types of straws

Final Solution

Increasing Production with Precision Agriculture (continued)

How accurate was your design? Record the amount of water that went into each cup.

Was your design successful?

_____

_____

_____

What could you do to improve your design?

_____

_____

_____

Why do you think that varying water amounts are useful?

_____

_____

_____

FOOD STORAGE: MAKING IT LAST!

For corresponding reading, check out Page 8 of More Than a Meal

Adapted from: Hunger Solutions Institute at Utah State University

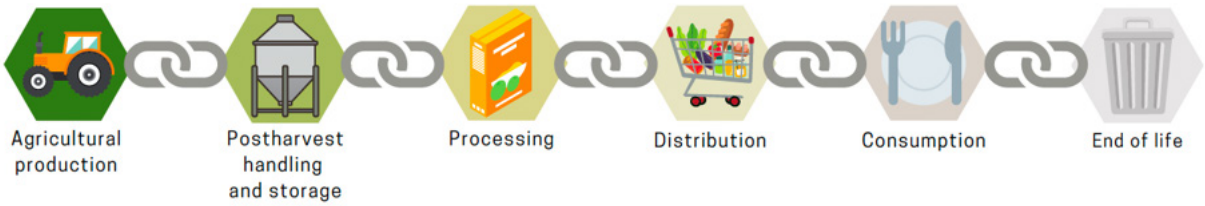
HSE.HS.21.6.f | *Label and store fresh and finished food products appropriately to reduce spoilage.*

Supplies Needed:

- 30 food items or images *Food Models can be printed for free and used for this activity:*
  - https://agclassroomstore.com/food-models/
- Food Chain image
- Rethinking Food images
- Large poster paper or large sticky pads (1 per group)
- Poster markers
- Oh, Scrap! e-reader (optional) *https://cdn.agclassroom.org/media/uploads/LP879/Oh,_Scrap!_2024_Update.pdf*
- Food Storage Poster Rubric, one per group
- Student access to the following additional resources for the activity:
  - https://www.foodsafety.gov/keep-food-safe/foodkeeper-app
  - https://blog.misfitsmarket.com/the-ultimate-fresh-produce-storage-guide/
  - https://blog.misfitsmarket.com/foods-that-last-longer-than-you-think/

Directions:

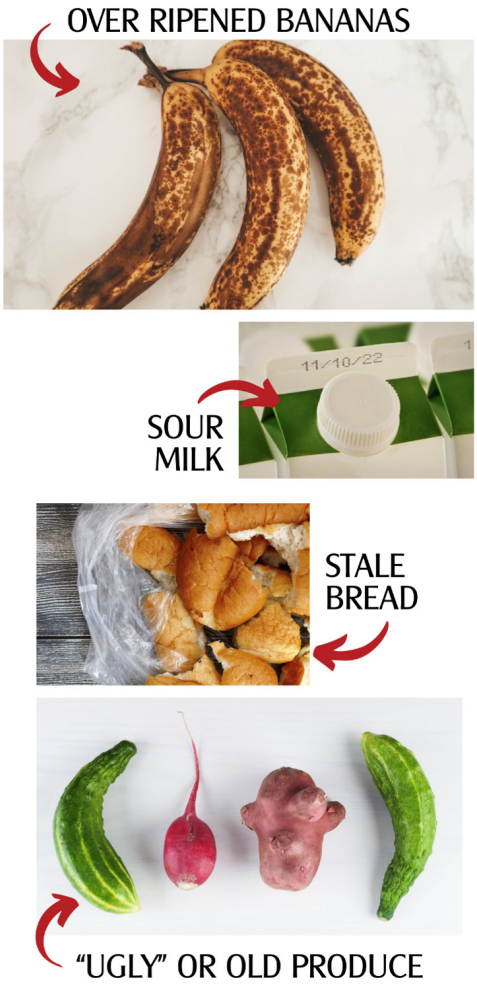
1. Gather various food items and/or food packages (about 30 items) and set them on a table in front of the classroom. This can include fresh produce, prepared meals, and packaged foods.
   - Consider using Food Models for this activity. You can print them yourself. These full-color, life-size images also represent suggested portion sizes for various food items.
2. Ask students, "If these items represent food in the United States, what percentage of this will end up wasted?"
3. Instruct students to select a number or percentage of the displayed food items that they think will be wasted in the United States.
   - For example, if you have 30 items on the table and students say 10 out of 30 will be wasted, this means they think about 33% of food is wasted in the United States. Separate your students' guesses from the rest of the items. (Slide 10 food products away from the group.)
4. Depending on your students' guesses, separate the correct number of food items that will be wasted. (Stay within 30% to 40%)
5. Explain to students that between 30% to 40% of food is wasted each year in the United States. This is equivalent to billions of pounds of food each year.
6. Project the Food Chain image on the board, or if using the Oh, Scrap! e-reader, have students turn to page 5.



7. Ask students, "Where along this food chain is food wasted?"
8. Allow students to share thoughts and ideas.
9. Explain to students that food waste can happen anywhere on the food chain. There is a larger environmental impact when food is wasted further down the food chain.
10. Ask students, "Where on this food chain can you implement food waste strategies and make a difference?" For most students, this will be distribution and consumption.
    - How can students make a difference during distribution? (Meal planning, not over purchasing items, checking expiration dates, etc.)
    - How can students make a difference during consumption?
11. Explain to students that they will now consider strategies and ideas for minimizing food waste at home.

Activity

1. Project the Rethinking Food image on the board.
2. Ask students to look at their options and ask:
    - Which of these products would you eat?
    - How many of you think you'd throw these items out?
3. Using think-pair-share, allow students to come up with ways they'd utilize these foods instead of throwing them away to prevent food waste.
    - Over-ripened bananas: banana bread, cookies, or muffins; pureed banana ice cream
    - Stale bread: croutons, French toast
    - Sour milk: yogurt or buttermilk
    - Ugly or old produce: soups, casseroles, stir-fry, sauces, and broths
4. Explain to students that as consumers (during the consumer stage of the food chain), they should be aware of additional meals that can be made with old, stale, or over-ripened foods. Solutions like this prevent food from ending up in the landfill.
5. Using the Proper Food Storage handout, discuss strategies to prevent food waste at home.
6. Divide students into groups of two to three. Simulate that groups have been hired by their local grocery store to create food storage information posters to help combat food waste and inform consumers about how to help their produce last longer. Allow each group to select a fresh fruit or vegetable. Groups will use large paper to create a poster following the rubric included.
7. Groups present their posters to the rest of the class. Hang posters for display in the classroom or consider reaching out to your local grocery store or cafeteria for the opportunity to display.
8. Summarize with the following key concepts:
    - Sixty percent of food waste occurs at the household level. Sustainable shopping, correct food storage, and meal planning can all help reduce food waste at home.
    - Food should be reconsidered before being wasted or thrown out. There are websites and online tools that can generate new recipe ideas for using food before it is thrown away.



Proper Food Storage

Storing Produce

Properly storing produce in the correct places in the fridge can affect how long they are good for:

- Store most vegetables in the high humidity drawer.
- Store most fruit and vegetables that tend to rot in the low humidity drawer.
- Some fruits release ethylene gas and can ripen and speed up the process of spoiling of surrounding produce. Place bananas, apples, pears, avocados away from other produce.
- Not all vegetables are refrigerated. Store potatoes, eggplant, winter squash, onions, and garlic in a cool, dry, dark, and well-ventilated place.
- Avoid washing berries, cherries, and grapes until you are

Freezing Food

Did you buy or make too much? You can freeze many foods and eat them later.

Bread

Sliced Fruit

Meat

Leftovers

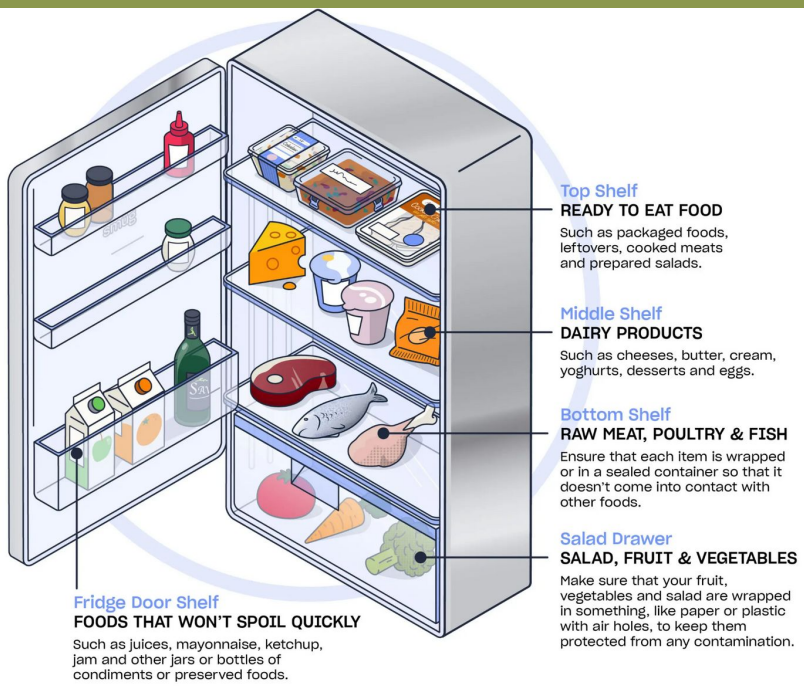
Make sure that you label and date the food you store in the freezer.

Proper Food Storage

Arranging Items in the Fridge

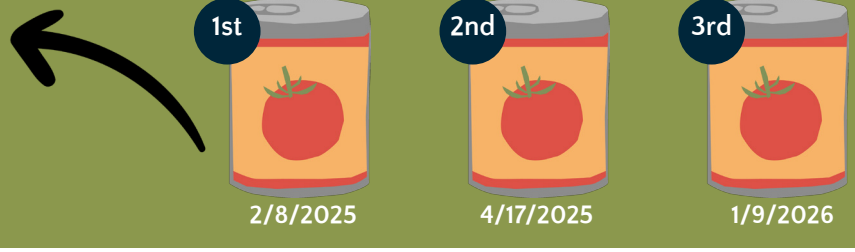
Refrigerators should be set to maintain a temperature of 40 °F or below.

Be aware of where raw meat gets placed. Make sure it is wrapped and placed on the lowest possible shelf so that meat juices don't



Proper Food Storage

First in, First Out



Leftovers

- Refrigerate or freeze any leftovers in clear, labeled containers with dates.
- The risk of food poisoning from eating leftovers increases after 3-4 days of being in the fridge. Consider having a "leftovers" night during your week.

Make sure that all containers (especially those with grain in them) are closed airtight.

Don't leave perishable food at room temperature for more than two hours.

Understanding Dates on Food

Best if Used By/Before

Indicates when a product will be of best flavor or quality. It is not a purchase or safety date.

Use By

The last date recommended for the use of the product while at peak quality. It is not a safety date except for when used on infant formula.

Sell By

Tells the store how long to display the product for sale for inventory management. It is not a safety date.

Freeze By

Indicates when a product should be frozen to maintain peak quality. It is not a purchase or safety date. Foods that are frozen indefinitely will always be safe to eat but the quality may decline with time.

So, how do I know when food has gone bad?

Spoiled foods will develop an off odor, flavor or texture due to naturally occurring spoilage bacteria. If a food has developed such spoilage characteristics, it should not be eaten.

FOOD STORAGE POSTER RUBRIC

Name: _____

Component to Include	My Check	Teacher Check	Points Assigned
Produce name: _____			
How long does it typically last?			
Where should it be kept for optimal storage?			
What conditions should be present for optimal storage?			
Creative ways to use or freeze item: include recipes or tips			
Photos			
Neatness			
Information Accuracy			
Source			