Five **Fun Facts** About Bell Peppers!

- Bell peppers are a slow-growing crop and take almost 180 days until their final harvest.
- All peppers start out green, but change to red, orange, yellow, purple and black as they ripen.
- California is the nation’s leading producer of bell peppers and more than 200 different varieties are grown throughout California.
- Bell peppers are not spicy because they are the only member of the pepper family to not contain capsaicin.
- Red bell peppers have twice the Vitamin C as green bell peppers.

Three **Fun Teaching Ideas**!

- Research the Scoville rating for a variety of peppers and have students graph their findings.
- Have students read about Bell peppers and complete the “Pass the Pepper” worksheet that can be found in the “From Start-to-Finish: Producing, Preparing, & Preserving California Specialty Crops in the Classroom” Student Workbook.
- Bell peppers are a common ingredient in salsas! See the lesson plan on the back of the Bell Pepper Fact and Activity Sheet and have students “Sort Your Salsa!”

*Explore all the great bell pepper resources in this section!*
Bell Peppers

How Produced – The pepper plant is a member of the **Solanaceae** or nightshade family, which also includes tomatoes and potatoes. Pepper plants are planted in the field as seeds or as young plants, called transplants. Bell peppers are warm-season crops, sensitive to freezing temperatures at any growth stage. The ideal growing temperature is between 75° and 85°F, with night temperatures between 55° to 65°F. If planting seeds directly into the ground, the producer typically sows seeds March through May. If planting by transplant, plants are grown in greenhouses for two months before being transplanted out in the field from March through July.

Bell peppers are a slow-growing crop, with up to 180 days until the final harvest. Due to their slow-growing nature, they face greater exposure to elements such as inclement weather, pests, and weeds. Therefore, bell pepper fields require significant input costs such as water, labor, and crop protection. Bell peppers are also susceptible to sunscald, which occurs when ripening fruit is not adequately shaded by leaf cover. Adequate fertilization to increase canopy coverage helps control this problem. The color of bell peppers change as they ripen on the vine. Most bell peppers are primarily sold as green peppers, but red, yellow, orange, purple, and black colors will show as the plants ripen. Peppers are ready for harvest between early July and October. Fresh market peppers are harvested by hand, with multiple harvests occurring within a single season. Peppers intended for processing are harvested mechanically. In this process, each plant is cut at the base and peppers are shaken from the plants. The shaken peppers are hand-sorted on the machine. Conveyor belts transfer the peppers into produce bins pulled by a tractor following alongside.

The bins are transferred onto flatbed trucks using a forklift. Trucks haul processing peppers to a facility where they are peeled, sliced, or diced into the familiar frozen, canned, or dehydrated pepper products seen on store shelves. Fresh market peppers are graded and packed in sheds located near the fields to assure maximum freshness.

History – About 9,000 years ago, the wild pepper plant originated near Bolivia and Peru. It was later cultivated for its fruits by the Olmecs, Toltecs, and Aztecs. The seeds spread throughout Central America by both nature (wind, animals) and human activity (migration, exploration).

Bell peppers were carried throughout the world by Spanish and Portuguese explorers. The misleading name “pepper” was given by Europeans when Christopher Columbus brought the plant back to Europe. Due to the versatility of the bell pepper, it quickly became a staple in diets throughout the world including Central Europe where they were dried and ground to make paprika. Commercial bell peppers were first grown in the United States in the early 1920s.

Varieties – Varieties are selected on the basis of yield potential, quality, market acceptability, and disease resistance or tolerance. There are nearly 200 different varieties of bell peppers grown throughout California for both fresh market and processing. These include varieties with the traditional multi-lobe shape as well as longer more pointed varieties. Common bell pepper varieties used for commercial production include: Huntington, Classic, and Baron.

Commodity Value – California is the nation’s leading producer of bell peppers. Last year, California’s pepper growers harvested more than 410,000 tons on 19,800 acres throughout the state. The state’s crop value reached $400 million in 2017. Most of California’s peppers are consumed within the US. Canada is the top export market, valued at $26 million.

Top Producing Counties – Riverside is the top producing county in California generating nearly $78 million. The second highest producing county is Ventura generating $61 million, followed by San Benito at $32 million, and Santa Clara at $19 million.

Nutritional Value – One serving of red bell peppers is an excellent source of vitamin A and vitamin C and a good source of vitamin B6. Vitamin B6 helps the body break down or metabolize protein, aids in the formation of red blood cells, and helps maintain normal brain function. Bell peppers are also an excellent source of dietary fiber and provide small amounts of several other vitamins and minerals.

For additional information:
California Pepper Commission
(559) 591-3925
Website: calpeppers.com
Bell Peppers Activity Sheet

Lesson Ideas

• Research preserved peppers throughout history and plot significant dates on a timeline.
• Study the anatomy of the bell pepper. Label the different parts.
• Examine the capsicum genus and compare the different species of peppers.
• Create an alliterative phrase about peppers. Try to say it three times fast.
• Compare the edible mass of a traditional bell pepper and a sweet mini pepper.
• Explore different types of preserved peppers and compare price per ounce.
• Identify cultures that use peppers in cooking and locate them on a map.
• Research the Scoville rating for a variety of peppers, make a bar graph to illustrate.

Fantastic Facts

1. Peppers are fruits because they are produced from a flowering plant and contain seeds.
2. Columbus and Spanish explorers named bell peppers while searching for peppercorn plants to make black pepper.
3. Bell peppers are called by different names throughout the world (US: bell pepper; England: pepper; Japanese: paprika; Australia: capsicum)
4. Red bell peppers have twice the vitamin C content as green bell peppers.
5. Bell peppers are the only member of the pepper family to not contain capsaicin, the main compound that gives chili peppers their heat.
6. Green bell peppers are less sweet and almost bitter since they have not been able to fully ripen.

Lesson Plan: Sort Your Salsa

Introduction: Peppers add color, flavor, and texture to salads, pizza, pasta, and ethnic foods. In recent years, salsa has become one of America’s favorite condiments. For every bottle of ketchup purchased, Americans are purchasing two jars of salsa. Along with fresh tomatoes, salsa often contains bell and chili peppers.

Objective: Students will analyze, determine ingredient ratios, and explore the essential role of peppers in salsa.

California Standards: CC Math: 3-4.MD.2, 6-7.RP.3

Materials: Fresh salsa that contains peppers, paper plates, toothpicks, cheesecloth, magnifying lenses

Procedure:
1. Before the lesson, use the cheesecloth to drain as much liquid as possible from the salsa.
2. Ask students to raise their hand if they have salsa in their home right now. Discuss the different styles of salsa. Have students raise their hands to vote for their favorite style.
3. Brainstorm ingredients of salsa and record them.
4. Predict the ratios of each ingredient in a salsa recipe.
5. Distribute toothpicks, a paper plate, and two tablespoons salsa to each group. Instruct groups to weigh and record the mass of their salsa.
6. Using toothpicks and magnifying lenses, instruct students to separate their salsa by ingredient. Find the mass of each ingredient. Record data.
7. Use proportional reasoning to convert weights to percentages (or degrees) and create a pie chart.
8. Compare results and discuss how peppers change the color, flavor, and texture of salsa.
Africa

Africa is the second largest and second most populous continent in the world. Much of Africa is an agrarian society—its economy is based on producing crops. Unlike the U.S., where less than two percent of the population are farmers, approximately 70 percent of Africans are directly engaged in farming. There are many crops grown in Africa—sweet potatoes and chili peppers are two popular foods produced in both Africa and California.

Sweet and Spicy
Sweet potatoes make a healthy and convenient snack no matter where you live! Californians enjoy sweet potato fries dipped in a variety of sauces. In Northeast Africa, sweet potatoes are sliced and sun-dried. The dried sweet potatoes are called amalko, and are enjoyed as is or cooked and accompanied with peanut sauce.

Chile peppers add a kick to cuisine all over the world. In California, chili peppers add spice to salsas and other Mexican dishes. Peppers are also added to American fare, such as hamburgers and hot dogs. In West Africa, hot pepper soup is a traditional cure for fighting the common cold.

Foldere for Foodies
During some African weddings, newlyweds taste foods that are sour, bitter, hot, and sweet to represent the different times in a marriage. Lemon, vinegar, pepper, and honey are most commonly used to represent these flavors.

Passports for Produce
Although popular in African and Californian cuisine, did you know Chile peppers and sweet potatoes originated in Central and South America?

Although Columbus and his fellow explorers to Central America discovered the pepper (named “pimiento” by Columbus himself), the Portuguese can be credited with the rapid adoption of chili peppers elsewhere in the world. The chili pepper first arrived in Africa from Central America via Portuguese trade routes during the 16th century.

Researchers have found evidence that sweet potatoes arrived in Africa through Columbus’s sail. Archaeologists believe that ancient samples of sweet potatoes found in Polynesia (dating back to 1000 AD) came from the western coast of South America. That would give Polynesia explorers a key role in transporting sweet potatoes from South America to the rest of the world.

Map It!
Use an online mapping tool to plot the routes sweet potatoes and chili peppers took as they traveled from the Americas to Africa.

Sizzle Scale
Can you name the world’s hottest pepper? Check out the Sizzle Scale to find out!

Capsicum is the spicy chemical compound found in peppers, and the Sizzle Scale indicates the amount of capsicum present. Write each pepper variety in the correct place on the thermometer and answer the related questions.

Pepper Variety
Zimbabwe Bird Chile
Piri Piri
Hot Banana*
Peppers*
Tabasco*
Jalapeno*
Aji Chombo
Anahiem*
Aji Peruvian
Habanero*

* Peppers grown commercially by California farmers.

1. How many more Serrano units does a Zimbabwe Bird Chile pepper have than a Peruvian Purple Pepper?

Scoville Heat Units.

2. Which pepper packs more heat, a Zimbabwe Bird Chile or a Habanero?

3. How many more times hotter is an Aji Chombo than a Jalapeno?

4. Would you try an Aji Chombo pepper?

- Yes
- No Way!
- Maybe

Writing Standards CC: Math 4® NF, A.1, 4® NF, A.2, 5® NF, A.1

Recipe

Amuseko
Source: passmetheway.blogspot.com
California’s sunshine and warm, dry climate provide the perfect conditions for a year-round sweet potato supply. In this recipe, the sun helps bake a unique West African snack.

Ingredients
4 sweet potatoes
2 tsp. dried herbs
2 lemon, juiced
1 Tbsp. olive oil

Procedure
1. In a large bowl, whisk together lemon juice, olive oil, and herbs.
3. Add potato slices to the lemon mixture and toss gently to coat.
5. Place the tray in the sun. Cover with cheesecloth to protect from insects. After 3-4 hours, turn the chips and sprinkle with more salt. Once completely dry, enjoy.

Sources: Time Magazine, Movement of the Chile Pepper (content.time.com)
U.S. Department of Agriculture and Natural Resources Extension (unrealtimes.com)
California Sweet Potato Council (californiawhtpotatoes.com)
Seed Match

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

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

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

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

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

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

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

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

Vocabulary:
- Help your students brainstorm adjectives to describe seed characteristics.
  - **Coat:** smooth, rough, dry, wet, spiky, soft, hard, sticky, etc.
  - **Color:** dark, light, black, brown, white, tan, grey, etc.
  - **Shape:** oval, round, teardrop, etc.
  - **Size:** small, medium, large, inches, centimeters, compare to size of a coin, a pencil’s eraser, a water drop, etc.

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

California Standards

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

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

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

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

Learn about Ag.org/WEGarden
<table>
<thead>
<tr>
<th>Seed Match</th>
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<tbody>
<tr>
<td><strong>Peanut</strong></td>
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<tr>
<td><strong>Cotton</strong></td>
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<td><strong>Pumpkin</strong></td>
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<td><strong>Watermelon</strong></td>
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<td><strong>Corn</strong></td>
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<tr>
<td><strong>String Bean</strong></td>
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<tr>
<td><strong>Bell Pepper</strong></td>
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<tr>
<td><strong>Cucumber</strong></td>
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</tbody>
</table>
LESSON TITLE:

PRESERVING THE POWERFUL PEPPER

Grade Level: 5-8
ONE 50-MINUTE LESSON

LESSON OBJECTIVES:
• Students will observe properties of preserved foods and state changes that have occurred.
• Students will understand the health benefits of probiotics.
• Students will preserve peppers to create their own probiotic food.

STANDARDS
• NGSS: MS-LS-1.5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
• NGSS: MS-PS-1.2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
• CA Health Education Content Standards: Grade 5: 7.2.N: Demonstrate how to prepare a healthy meal or snack using sanitary food preparation and storage practices.
• CA Health Education Content Standards: Grades 6-8: 1.1.N: Describe the short- and long-term impact of nutritional choices on health.
• CC ELA: RST-6-8.3: Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text (e.g., through examples or anecdotes).
BACKGROUND INFORMATION

One characteristic of produce is its perishability. Unless produce is eaten within a relatively short timeframe, it must be preserved. Once preserved, the nutritional value is maintained and the presence of pathogens can be avoided. Bell peppers are perishable and can last up to three weeks whole, but typically only a few days once cut.

Bell peppers are most often preserved by freezing or pickling. These preservation processes help maintain the nutritional value of the pepper for up to one year. Peppers are an excellent source of vitamin C and vitamin A. Vitamin A and vitamin C are antioxidants, which are substances that remove potentially damaging oxidizing agents (sometimes called free radicals) in a living organism—humans included. Eating one red bell pepper provides 100 percent of the vitamin C and 45 percent of the vitamin A the body needs each day. Studies suggest that nutrients found in red bell peppers reduce stress, lower inflammation, and decrease the risk of cardiovascular disease and cancers.

Eating preserved peppers that have been pickled offers additional health benefits. During the pickling process, live microorganisms are introduced. These microorganisms are linked to numerous health benefits when consumed, including weight loss, improved digestion, enhanced immune function, better skin, and a reduced risk of many diseases.
PROCEDURE (PART 1)

1. Before the lesson, write the words “perishable,” “preserve,” and “probiotic” across the whiteboard or chart paper.

2. Show students a fresh bell pepper and a spoiled bell pepper in a sealable bag. Pass around the peppers and discuss the differences in appearance, smell, and texture.
   - As students make comments about the spoiled pepper, capture brainstormed words around the word “perishable.”
   - Ask students what methods could be used to maintain the texture, flavor, and nutritional value of the pepper. Guide students towards the words: canned, dried, frozen, and pickled. Capture these words around the word “preserve.”
   - Ask students to consider the origin of the word “probiotic.” Explain that the Latin prefix “pro” means for and the Greek root “bio” means life. Capture these words around the word “probiotic.”


4. Allow students 10-15 minutes to complete the text analysis. Collect student work and assess for completeness and accuracy.

PROCEDURE (PART 2)

1. For this activity, prepare the *Pepper Brine Recipes* in advance. Create one batch of each recipe. Place containers on a clean table top with cups or utensils for pouring into jars.

2. At the beginning of the lesson, remind students that before working with any type of food it is important to make sure that the environment is clean and hands are washed. Review classroom protocol for hand washing.

3. Tell students that today they will be creating their own probiotic food, pickled peppers. They will be fermenting two jars of peppers, one sweet and one sour. Divide students into groups of five. Distribute the *Creating Pickled Bell Peppers* lab handout. Read the instructions together, answer questions, and circulate around the room to guide students through the lab.
4. Provide opportunities for students to make daily observations of their pickled peppers for the following six days. After six days, sample the peppers and discuss the following questions:

- **What changes did you observe in your pickled peppers over the course of six days?**
- **Based on your reading of Perfectly Pickled: Probiotics Pack a Punch, what key ingredients must be in the brine recipe to promote the growth of good bacteria?**
- **Why was it important to keep jars sealed and refrigerated during the process?**
- **How did the fermentation process change the flavor and texture of the bell peppers?**
- **Did this experiment cause a chemical or physical reaction? Use evidence to support your claim.**

**VARIATIONS**

- Provide a variety of fresh or dried herbs for students to add to their pickled pepper recipe. Organize a class taste test and vote to determine the most flavorful recipe.

- Use bell peppers grown as part of a school gardening project.

**EXTENSIONS**

- Browse the many different episodes of The Fermentation Podcast and listen together to learn more about the health benefits of fermented food. *(fermentationpodcast.com)*

- Compare the cost of fresh bell peppers with value-added products like pickled peppers or roasted bell peppers. Calculate the percent increase per ounce for value added products.

- The Exploratorium website features articles about fermented foods and additional experiments. Learn more at exploratorium.edu/cooking/pickles.
Perfectly Pickled: Probiotics Pack a Punch

Long before probiotics became a health and nutrition buzz word, cultures throughout history and across the globe were celebrating fermented, or pickled, foods. Historically, the process of pickling foods was intended as a preservation method. Today, nearly every global culture includes at least one fermented food in its culinary heritage.

Russian microbiologist Elie Metchnikoff (1845-1916) was the first to associate the consumption of fermented dairy products with the good health and longevity of Bulgarians back in 1907. He proposed that the acid-producing bacteria in fermented dairy products could prevent what he called “fouling” in the large intestine. He believed if eaten regularly, these foods could lead to a longer, healthier life.

It is increasingly understood that consuming certain types of microorganisms, also called bacteria, may have positive health outcomes. Our bodies are home to both good and bad bacteria. They are everywhere, including the stomach. Under normal conditions, good bacteria in the stomach outnumber the bad bacteria. Probiotics found in pickled foods provide a boost in healthy bacteria and create a physical barrier against unfriendly bacteria.

Lactic acid fermentation, or lacto-fermentation, is among the most common methods and one of the easiest to experiment with at home. In this type of fermentation, the vegetable is soaked in a salt brine, allowing the growth of bacteria that eat the vegetable’s sugars and produce tart-tasting lactic acid. Salt plays a pivotal role in traditional fermentation by creating favorable conditions for the good bacteria, preventing the growth of bad bacteria, and adding flavor.

According to the Harvard School of Medicine, the scientific community agrees that there are potential health benefits to eating foods with probiotics. However, more research is needed to solidify the claims. Medical researchers affirm, “the best we can say right now is they won’t hurt and may help.”


Perfectly Pickled: Probiotics Pack a Punch

1. Give two examples of fermented foods and the cultures they originated in.

2. What did Russian microbiologist Elie Metchnikoff believe about fermented foods?

3. What is one of the most common methods of fermentation?

4. In your own words, what are probiotics?

5. What does lactic acid bacteria do?

6. What role does salt play in the fermentation process?

7. Should people be encouraged to eat foods with probiotics? Why or why not?
Perfectly Pickled: Probiotics pack a punch

1. Give two examples of fermented foods and the cultures they originated in.
   *Examples of fermented foods include Kimchi (Korea), Kombucha (China), Miso (Japan), Chutney (India).*

2. What did Russian microbiologist Elie Metchnikoff believe about fermented foods?
   *Russian microbiologist Elie Metchnikoff believed bacteria in fermented dairy products could prevent “fouling” in the large intestine. He believed eating fermented foods regularly could lead to a longer, healthier life.*

3. What is one of the most common methods of fermentation?
   *Lactic acid fermentation is among the most common methods of fermentation.*

4. In your own words, what are probiotics?
   *Probiotics are bacteria that are good for you. When eaten, they increase the good bacteria in your gut and protect against the bad bacteria.*

5. What does lactic acid bacteria do?
   *Lactic acid bacteria is bacteria that is grown with vegetables in a salt brine. The bacteria eat the vegetable’s sugars and produces lactic acid.*

6. What role does salt play in the fermentation process?
   *Salt plays a pivotal role in traditional fermentation by creating favorable conditions for the good bacteria, preventing the growth of bad bacteria, and adding flavor.*

7. Should people be encouraged to eat foods with probiotics? Why or why not?
   *Answers will vary.*
PEPPER BRINE RECIPES

Altering quantities—especially those of vinegar, vegetables, and salt—can lead to the spread of spoilage-causing bacteria. Scrupulously clean all cooking utensils in hot, soapy water. Rinse thoroughly.

**SOUR PEPPER BRINE RECIPE**

**INGREDIENTS:**
- 3 cups distilled white vinegar or cider vinegar
- 3 cups water
- 2 tablespoons plus 2 teaspoons sea salt
- 2 tablespoons sugar

Combine all ingredients in a large pan over high heat and bring to a boil until salt is dissolved. Continue boiling for two minutes and remove from heat. Store in a large container labeled “Sour Pepper Brine.”

**SWEET PEPPER BRINE RECIPE**

**INGREDIENTS:**
- 3 cups distilled white vinegar or cider vinegar
- 3 cups water
- 1 tablespoon plus 2 teaspoons sea salt
- 1 1/2 cups sugar

Combine all ingredients in a large pan over high heat and bring to a boil until salt and sugar is dissolved. Continue boiling for two minutes and remove from heat. Store in a large container labeled “Sweet Pepper Brine.”
IN THIS ACTIVITY, YOUR GROUP WILL MAKE TWO DIFFERENT VERSIONS OF PICKLED PEPPERS BY USING DIFFERENT BRINE RECIPES. ONE VERSION WILL PRODUCE SOUR PICKLED PEPPERS AND ONE VERSION WILL PRODUCE SWEET PICKLED PEPPERS. READ AND COMPLETE EACH STEP CAREFULLY.

1. Sanitize your tabletop area with disinfectant wipes.

2. Wash your hands.

3. Retrieve glass pint jar with lid.

4. Fill pint jar with chopped bell peppers, to within 1/2 inch of top.

5. Fill jar with brine to cover peppers.

6. Seal jar with lid and wipe clean.

7. Label jar with masking tape and permanent marker. Include group members’ names, date, and brine used (sweet or sour).

8. Repeat process using alternate brine recipe.

9. Refrigerate both jars for approximately six days.
   a. Monitor daily to ensure the brine is completely covering the peppers, add more brine as necessary. Do not open jars during monitoring, unless necessary.
   b. After six days, remove the film present on the surface. If the film is white and flat, it is most likely yeast. Yeast is a common occurrence in pickled vegetables, it is not harmful, but should be removed from the jar.
   c. Sample and compare the sweet and sour versions.

10. Reflect on the these questions; your teacher may ask you to write or discuss:
    a. What changes did you observe in your pickled peppers over the course of six days?
    b. Based on your reading of Perfectly Pickled: Probiotics Pack a Punch, what key ingredients must be in the brine recipe to promote the growth of good bacteria?
    c. Why was it important to keep jars sealed and refrigerated during the process?
    d. How did the fermentation process change the flavor and texture of the bell peppers?
    e. Did this experiment cause a chemical or physical reaction? Use evidence to support your claim.