

GRADE LEVEL: 5-8 | TIME REQUIREMENT: 3 HOURS

CHEMISTRY: MIXTURES AND REACTIONS

1 READING | 2 ACTIVITIES

INTRODUCTION

World War II required massive changes in the everyday lives of Americans, whether on the Home Front or serving overseas. While many Americans had learned to be creative to make ends meet and to keep food on the table during the Great Depression, the changes brought on by World War II were huge by comparison. All through World War II, growing Victory Gardens, cooking your own produce, and canning to preserve foods were both family survival strategies and government programs.

Although you might not initially think so, cooking is, to put it simply, applied chemistry. Recipes are instructions to make both mixtures and controlled chemical changes. Physical and chemical properties and physical and chemical changes are important topics for elementary and middle school science. The difference between physical and chemical changes can be difficult for students to comprehend. Thus, examples, especially those that connect to everyday life, are valuable.

OBJECTIVE

Use these three resources together to introduce the ideas in an engaging sequence that will introduce chemistry concepts while connecting them to nutrition and cooking. You can start by introducing rationing, and the limits on resources and consumption that created challenges during WWII. Then students will make some food that they might like to eat, exploring chemistry, physical and chemical changes, and properties of materials.

STANDARDS

NGSS DCI PS1.A
Structure and Properties of Matter

NGSS DCI PS1.B
Chemical Reactions
NGSS DCI PS3.A: Definitions of Energy

NGSS DCI LS1.A
Structure and Function

NGSS DCI LS1.C
Organization For Matter and Energy Flow in Organisms

NGSS SEP
Developing and Using Models

NGSS SEP
Constructing Explanations and Designing Solutions

NGSS CCC
Structure and Function

NGSS CCC
Energy and Matter

PERFORMANCE EXPECTATIONS

5-PS1-1
Develop a model to describe that matter is made of particles too small to be seen.

5-PS1-4
Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

MS-PS1-2
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-LS1-2
Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.

READING (1)

1. RATIONALE FOR RATIONING

Description

This reading provides a real-world context for the activities in this unit. This resource answers the questions of why people needed to grow and make their own food and why they had to understand the chemistry of how prepared food is made. Have students work in groups using Kagan structures to discuss the reading. How do students think rationing would work today? How much of products like sugar do they consume compared to the WWII-rationed amount? What do students think might be rationed today that was not rationed then?

ACTIVITIES (2)

1. KITCHEN SCIENCE: GUMMIES

Description

Engage students in exploring changing properties of materials by making mixtures. Is the result of this recipe a chemical or a physical change? The process in this recipe is a physical change in which the long molecular strands of gelatin dissolve in the heated mixture and then, as they cool, stretch and tangle to form a gel. Vitamin C is a nutritional benefit that also lowers the pH, which humans also find to be yummy. To add a demonstration of chemical change, cook some pancakes on a hotplate. The key difference between chemical and physical change is in what molecules are present before and after. At both the beginning and the end of this activity, you will have gelatin, water, and vitamin C. The molecules have mixed and changed their form after warming and then cooling—an example of physical change. In the pancakes, there is odd-tasting baking soda present before while carbon dioxide gas makes bubbles and fluffs the batter. The chemical composition and the types of molecules present, are different before and after cooking—an example of chemical change. Another activity that can be added to demonstrate physical change in a dramatic way uses only two supplies—a pint mason jar and a half-cup of heavy cream. The mixture will first become whipped cream, and then with continued shaking will separate into butter and finally into buttermilk. Before and after, it is water, fat, and a small amount of protein and sugar; the shaking separates the mixture into parts.

Supplies (per group)

Silicone candy mold and dropper
1/2 Cup fruit juice
1/2 Tbsp vitamin C powder (optional)
2 Tbsp powdered gelatin (unflavored)
2 Tbsp sugar
Small saucepan, rubber spatula, and hotplate

Instructions

Remind students to be very careful with the hotplate, and enforce the use of safety goggles to avoid hot splatter. Students will need to keep the temperature at medium so that they don't evaporate too much juice. Add the vitamin C,

and then add the gelatin very slowly. Refrigerate or freeze the gummies if you can so that it cools quickly. If not, the activity will still work, but will take longer to solidify. There are more detailed instructions in the student activity on page 56.

An alternate activity that demonstrates physical change is the making of butter. All you need for this activity is a pint mason jar with a lid and 1/2 cup of heavy whipping cream. Have the students take turns shaking the mason jar. If it starts cold, it will take about 5-10 minutes of shaking to become whipped cream. You'll notice this change because there is no more sloshing in the jar. It will then take another five minutes to separate into butter and buttermilk. If it starts warm, the mixture will go straight to butter in about 10 minutes.

For the pancake demonstration, bring some batter, or prepare it in front of the students and cook it on a hotplate in a small pan. Show the bubbles forming and break open a pancake to show the bubbles that make it fluffy.

If you do make butter AND pancakes, they go pretty well together.

2. KITCHEN SCIENCE: PICKLES

Description

An activity that demonstrates physical change, but one that has further connections to chemistry and biology. Give each group of students sliced cucumbers, or give them a safe butter knife and a whole cucumber. With the butter knife students will make relatively thick slices, but the activity will still work. Ideally the pickles would sit in the briny vinegar for 24 hours, but they are pretty crunchy and yummy an hour after. The pickles will stay good in the fridge for a month. This is an example of physical change because there is no change in the arrangement of molecules. Brining in this way creates a greater concentration of salt and acid in the liquid outside the membranes of the fresh cucumber. The salt and vinegar molecules move inside the cucumber (diffusion), pickling it. Some water may also leave the cucumber (osmosis), which is why you don't want to make the solution too strong. If you leave a cucumber slice on a plate covered in salt, it will become limp, because of osmosis. A variation of this activity would be to pickle other vegetables, like beets or green beans.

Supplies (per group)

1 Pint-sized mason jar with lid
1 Cucumber, thinly sliced
3/4 Cup hot water
3/4 Cup white vinegar
1 Tbsp kosher salt or sea salt
Dill, peppercorns, or other seasonings (optional)

Instructions

Add the sliced cucumbers to the jar with the seasonings (if you are using them). In a separate container, dissolve the salt in the hot water and mix with the vinegar. Add that mixture to the jar, and then close the lid. Shake well.

ACTIVITY**KITCHEN SCIENCE: PICKLES**

INTRODUCTION

During World War II, many kinds of foods were in short supply. Families were encouraged to keep Victory Gardens in which they grew their own produce. People were urged to can what they could not eat fresh so that they could eat later when those foods were out of season. Because citizens were coming out of the Great Depression, growing and cooking food at home was not unusual. Such home-based activities are less common today because of how dependent we have become in many parts of the country on industrial agriculture.

CANNING

takes advantage of the principles of biology. Microbial growth can be reduced and food can be altered with the addition of some simple ingredients. Refrigerator pickles are an example of this simple use of technology to extend the shelf life of fresh produce. This process will allow fresh vegetables to be kept for a month or more while refrigerated.

You will need the following:

- 1 Pint-sized mason jar with lid
- 1 Cucumber, thinly sliced
- 3/4 Cup hot water
- 3/4 Cup white vinegar
- 1 Tbsp kosher salt or sea salt
- Dill, peppercorns, or other seasonings (optional)

Add the sliced cucumbers to the jar with the seasonings (if you are using them).

In a separate container, dissolve the salt in the hot water and mix with the vinegar.

Add that mixture to the jar, and then close the lid. Shake well.

Your pickles can be enjoyed in an hour or two and can be preserved at cool temperatures for a month.

NAME:**DATE:**

1. What is happening to the cucumber slices in the jar? Is this an example of a chemical change or a physical change?

2. Draw a diagram to explain your thinking:

- Define diffusion.
- Define osmosis. (diagram of osmosis and diffusion)

**3. Go back to your diagram and explain where osmosis and diffusion are occurring in the jar.
Why does pickling slow microbial growth?**