

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.

## READING

## THE RATIONALE FOR RATIONING

Many materials were in short supply during World War II. There were 16 million US troops fighting for victory, and 117 million people on the Home Front working hard to support them. Propaganda posters displayed throughout communities all told Americans how important it was to support the war effort in any way they could. People grew their own food, saved and reused material as much as possible, and went without some household items and personal comforts in order to aid the war effort.

One of the most dramatic ways World War II affected people's lives was rationing. Rationing is a systematic program or regimen that limits the amount of materials and supplies that an individual can purchase or consume. During the war, rationing controlled prices and supported equitable distribution of resources. Tires (and anything else made of rubber), sugar, meat, butter, cheese, milk, eggs, tea, chocolate, cloth, wood, metal, leather, paper, ink, bicycles, cars, fuel, and shoes were all rationed at times during World War II.

In the spring of 1942, every family registered for rationing through their local schools. On a trip to a grocery store for any rationed item you wished to purchase, you needed to be able to pay for it with both money and ration stamps. As supplies and conditions changed, the types of stamps and what was rationed also often changed. Stamps had to be torn out in front of the grocer at the time of sale so that people wouldn't try selling individual stamps.

To make groceries last longer, families were encouraged to can their own food. Since canning usually needed sugar, families who were canning could apply for more rations of sugar. Otherwise, families could only get one pound of sugar every two weeks for each person in the house.

Along with rubber for new tires, gasoline for cars was also rationed. The amount of gasoline you were entitled to depended on your job. This method allowed drivers to buy enough gas to get to and from work. If you could take the bus to work, or if you worked at home, you got an A-sticker for your car and you got about three gallons of gas a week. Supplies got even tighter in early 1945. As the Allies began to liberate parts of Europe, the United States took responsibility for providing food to refugees. The war had caused a great deal of damage to farms and manufacturing in Europe, and supplies to clothe and feed the people there had to be brought in. Rationing didn't last long in the United States after the war, but in England, which suffered a great loss of production of food and goods from the war, rationing lasted until 1954—nine years after the end of World War II.

UNITED STATES OF AMERICA  
OFFICE OF PRICE ADMINISTRATION

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**WAR RATION BOOK No. 3** Void if altered

Identification of person to whom issued: PRINT IN FULL

Bertha M. Andrews  
(First name) (Middle name) (Last name)

Street number or rural route \_\_\_\_\_  
City or post office Jandary State Illinois

AGE	SEX	WEIGHT	HEIGHT	OCCUPATION
50	Female	150 lbs.	5'8 1/2"	Housewife

SIGNATURE Bertha Mae Andrews  
(Person to whom book is issued. If such person is unable to sign because of age or incapacity, another may sign in his behalf.)

**WARNING**  
This book is the property of the United States Government. It is unlawful to sell it to any other person, or to use it or permit anyone else to use it, except to obtain rationed goods in accordance with regulations of the Office of Price Administration. Any person who finds a lost War Ration Book must return it to the War Price and Rationing Board which issued it. Persons who violate rationing regulations are subject to \$10,000 fine or imprisonment, or both.

OPA FORM No. R-130

**LOCAL BOARD ACTION**

Issued by \_\_\_\_\_ (Local Board number) \_\_\_\_\_ (Date)

Street address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

\_\_\_\_\_  
(Signature of issuing officer)

U.S.P.A. VALID NOT VALID WITHOUT STAMP

The front cover of a WWII ration book.  
(Image: The Education Collection of The National WWII Museum.)

NAME:

DATE:

## HOW TO SHOP WITH WAR RATION BOOK TWO

### ... to Buy Canned, Bottled and Frozen Fruits and Vegetables; Dried Fruits, Juices and all Canned Soups



**1. USE THIS RATION BOOK.** You may use one or all of your family's ration books when you shop. You may not shop with loose ration stamps.



**2. USE BLUE STAMPS ONLY.** All blue point stamps marked A, B, and C are good during the first ration period. They add up to 48 points for each member of the family.



**3. THE NUMBERS SHOW POINTS.** You will not be able to get "change" in point stamps, so save your low-value stamps for buying low-point foods.



**4. LOOK AT THE POINT VALUES before you buy.** Points have nothing to do with prices or quality. Point values will be the same in all stores.



**5. GIVE THE STAMPS TO YOUR GROCER.** Test out stamps in the presence of your grocer—or tear them out in the presence of the delivery boy.



**6. FRESH FRUITS AND VEGETABLES are not rationed.** Use them instead of rationed foods whenever possible. Try out recipes that make your rations go farther.

**YOUR POINT ALLOWANCE MUST LAST FOR THE FULL RATION PERIOD**

**Plan How Many Points You Will Use Each Time Before You Shop**



**BUY EARLY IN THE WEEK**

Foods are going to our fighting men. They come first! Your ration gives you your fair share of the foods that are left.



**BUY EARLY IN THE DAY**



A US Government poster explaining how to use ration books.  
(Image: The Education Collection of The National WWII Museum.)

1. What circumstances do you think could lead the government to start rationing today?

2. Do you go grocery shopping with your family? How would your shopping trips change if you had to use a ration book like the ones in World War II? Think about butter and sugar or about things that might not have been necessities then, but are today.