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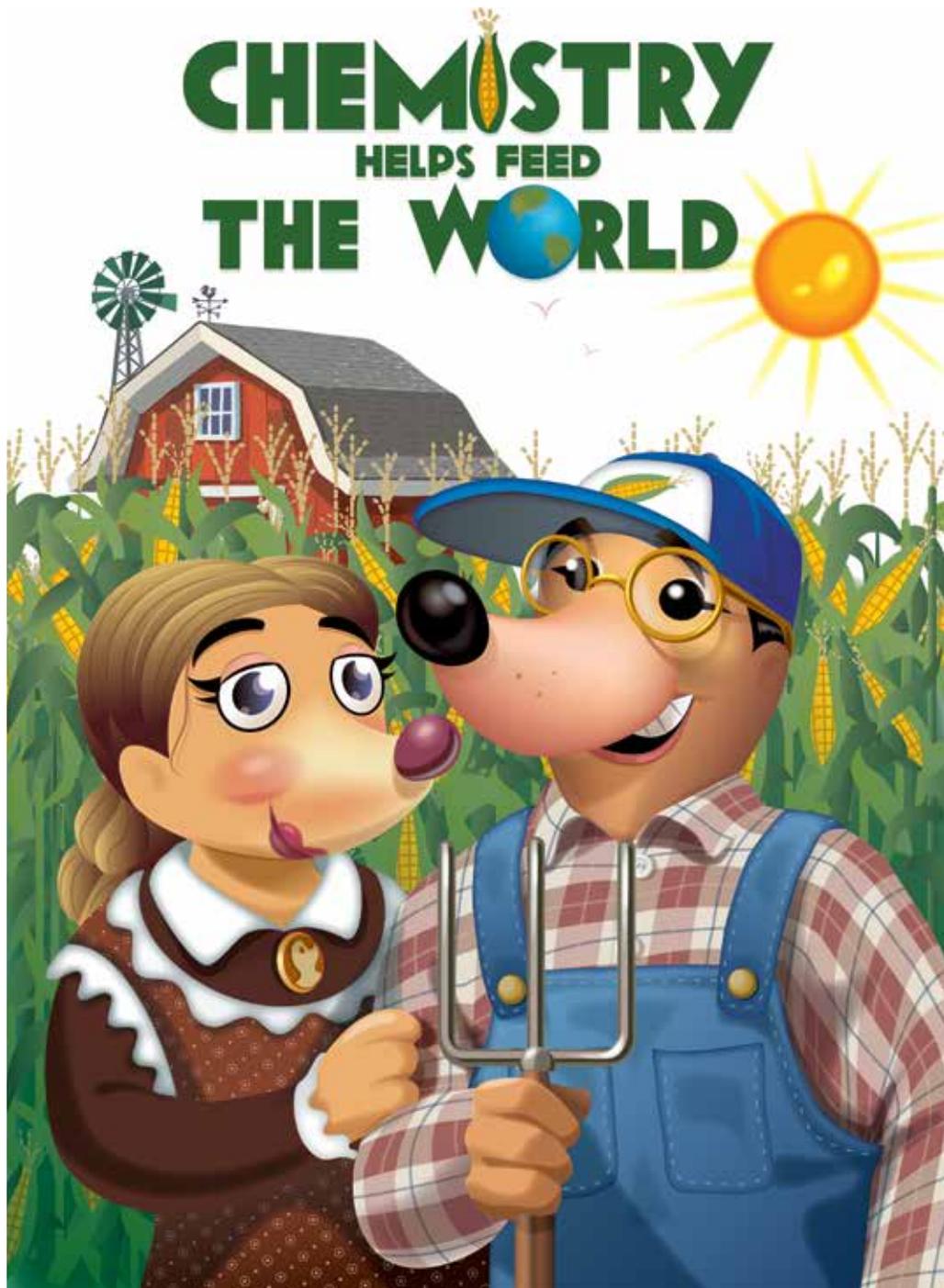


# Celebrating Chemistry

CHEMISTS CELEBRATE EARTH DAY

AMERICAN CHEMICAL SOCIETY

**CHEMISTRY**  
HELPS FEED  
**THE WORLD**





# Chemistry Helps Feed the World

By Richard Rogers

**T**he world population is estimated to be about 7.5 billion people, and growing by about 1.1% per year. That's a lot of mouths to feed! But there is other work to be done, too. Just like you, these people need a place to live, which means there will be less land available for agriculture ... and that means we can't grow as much food!

So, how are we going to feed all these people? Chemistry can help. Chemical analysis of the soil can tell farmers which nutrients are needed and how much of them to use. Chemists can also tell when too many nutrients have been used, and where the extra nutrients travel to. There are also chemists who develop herbicides and pesticides to help keep the crops safe. Of course, these chemicals also have to be safe for farmers and their families, and also for the people who eat the food. The same chemists also work to make sure that the nutrients don't harm helpful animals, such as bees and butterflies.

Chemists help farmers preserve their crop once it's grown, so that it can get to the people who need it, while it's still edible. No one likes rotten food! There are also chemists working in the pharmaceutical industry to develop medicines to keep farm animals healthy so we can all continue to get delicious milk, eggs, and bacon. Products from these animals also give us other useful items, such as leather.

Some of the world's most important crops are those that provide us with **carbohydrates**. Carbohydrates are natural

**polymers** made up of carbon, hydrogen, and oxygen. The most important ones are **starches** and **sugars**. They provide energy to the body when they are eaten and digested, although eating too much of them can lead to problems such as diabetes.

Sources of carbohydrates are different all around the world. In the U.S., we get carbohydrates mainly from wheat and corn. In Asia, people get carbohydrates mostly from rice, but also from tapioca. Meanwhile, in Europe, most people get carbohydrates from potatoes and wheat. Other sources of carbohydrates include quinoa, sorghum, barley, and others.

People eat these carbohydrates in either their "raw" form, or after they've been made into popular forms like bread, tortillas, cereals, French fries, and many other goodies. Chemists can modify these starches so that they stay good longer. For example, some starches are modified so that cheese sauce stays fluid, gravy gets thick (but not too thick), pie fillings get thick and stay that way, and many more. Look at the labels on foods for modified food starch — it's all made by chemists!

## References

<http://www.worldometers.info/world-population/>  
<https://prezi.com/oyxqsf6jfnccg/chemistry-in-farming/>

***Richard Rogers** is a Senior Research Chemist at Grain Processing Corp.*

# Three Layer Float

By George Fisher

## Introduction

**H**elium-filled balloons are fun because they float in air. Why? The answer has to do with differences in **density**. Density measures how many particles of matter are packed into the same volume. Things **float** when you put them in other substances that are more dense, and **sink** when they're placed in substances that are less dense. That's why the balloon floats: helium gas is less dense than air.

What about liquids? Do they do the same thing? In this experiment, you will compare the densities of different liquids and solids.

## Materials

- Honey
- Cooking oil
- Water (food coloring can be added to the water to make it more visible)
- Dish soap
- Glass marble
- Grape
- Piece of cork
- Tall clear bottle or glass

## Procedures

1. Pour honey into your glass or bottle until it's about one inch high.
2. Pour the same amount of cooking oil slowly down the inside of the glass. Make observations.
3. Pour the same amount of water slowly down the inside of the glass. Make observations.
4. Make a guess as to what will happen when you add the dish soap. Then pour the same amount of dish soap down the inside of the glass to see if you are right.

Which liquid is the most dense?

Compare the densities of all the liquids to each other.

One by one, drop the marble, grape, and cork into the glass. What happens to each of these objects? What does this tell you about the density of each of these objects? Which of your solid objects is the most dense? Try some other small objects to find out about their densities.



## Safety Suggestions

- ✓ Protective clothing suggested
- ✓ Do not eat or drink any of the materials used in this activity
- ✓ Thoroughly wash hands after this activity



## What do you see?

The liquids do not mix, but separate into layers. The oil floats on the honey; the water sinks underneath the oil, but floats on the honey. All three items (marble, grape, cork) each end up in one of the three liquid layers.

## How does it work? Where's the chemistry?

Each of the four liquids has a different density. The oil is the least dense liquid, so it floats on the other liquids. Honey is the most dense, so it sinks to the bottom. The liquids layer according to their densities. From least dense to most dense, the liquid layers are oil, water, dish soap, and honey. The solids will float on the liquid layer that is more dense than they are. The cork is less dense than oil and floats on the oil. The glass marble is more dense than honey so it sinks to the bottom of the glass. Where did your grape end up?



## TRY THIS!

Try this experiment with other liquids like vinegar, syrups, ketchup, and peanut oil. Make a guess before you start as to how they will layer.

## References

- [http://wikieducator.org/Three\\_Layer\\_Float](http://wikieducator.org/Three_Layer_Float)
- <http://www.lovemyscience.com/threelayerfloat.html>

*George Fisher is a Professor of Chemistry at Barry University in Miami, Florida.*



## Milli's Safety Tips Safety First!

### ALWAYS:

- Work with an adult.
- Read and follow all directions for the activity.
- Read all warning labels on all materials being used.
- Use all materials carefully, following the directions given.
- Follow safety warnings or precautions, such as wearing gloves or tying back long hair.

- Be sure to clean up and dispose of materials properly when you are finished with an activity.
- Wash your hands well after every activity.

**NEVER** eat or drink while conducting an experiment, and be careful to keep all of the materials away from your mouth, nose, and eyes!

**NEVER** experiment on your own!



# More than Letters of the Alphabet!

By Marilyn D. Duerst

**E**ven before you were in kindergarten, you probably learned your ABC's, the letters of the English alphabet. Chemists use letters of the alphabet to represent **elements**.

Three elements that plants need to grow well are represented by the letters N (**nitrogen**), K (**potassium**), and P (**phosphorus**). That's why most fertilizers include chemicals that contain the elements N, K, and P. Most homeowners use a fertilizer on their lawns and home gardens. In modern agriculture, huge farms produce corn, wheat, soybeans, and a wide variety of vegetables for our dinner tables. Farmers use enormous amounts of fertilizers to keep plants healthy and strong.

N stands for the element nitrogen ... and is its first letter! Plants need nitrogen to form proteins in the plant cells and for proper growth of the plant. Nitrogen gas is about 3/4 of Earth's atmosphere, but the nitrogen in the air can't be used by plants, because it consists of pairs of nitrogen atoms, bonded tightly together, with the chemical formula  $N_2$ . So, to be effective, fertilizers must have the nitrogen atoms bonded to other kinds of atoms. Ammonia gas has nitrogen bonded to hydrogen atoms in the formula  $NH_3$ . It is usually mixed with water when sprayed onto the fields. Ammonia stinks and makes the eyes sting; it is an ingredient used in some spray household cleaners and develops in wet baby diapers after standing for a period of time. P-U! Other compounds containing nitrogen, such as nitrates (nitrogen combined with oxygen), are often used in fertilizer to give the plant the nitrogen atoms it needs.

K stands for the element potassium, even though there is no letter K in the word. The "K" actually comes from the old Latin word for this element: "kalium." Plants need potassium ions (tiny charged particles) to maintain the sodium/potassium balance in their cells. Some natural potassium is present in all soils in the form of minerals, but may not all be available in a form that a

plant can use. Potassium can be added by putting compost, wood ashes, or ground granite in a garden.

P stands for the element phosphorus, which starts with the letter P, but is pronounced like an F, as it does in the word "phone." Plants need phosphorus to help form DNA in the cell nucleus, which helps them to make new cells and grow. Elemental phosphorus can be white or dark red, and is very flammable, so we can't use the elemental form. Most fertilizers are made from finely crushed "phosphate rock," which consists mostly of tiny bones of ancient sea creatures. Those bones are made of calcium phosphate. Calcium phosphate dissolves very slowly in soil. Did you know that much of the phosphate rock in the U.S. is found in central Florida, Georgia, and North Carolina?

Fertilizers are rated by three numbers, such as 16-4-8. The first number refers to the nitrogen content, the second to the potassium, and the third to phosphorus. Different fertilizers are used for specific types of plants.

What if farmers used TOO MUCH fertilizer on their crops? Rain may dissolve extra fertilizer, which flows into the soil and then into local ground water, rivers, and lakes. Too much phosphorus in the water causes green algae to grow rapidly in lakes. This algae blocks sunlight, so that other plants can't grow. When the algae dies and rots, it takes oxygen from the water, and fish suffocate. This process is known by a fancy word, **eutrophication**.

Lawn fertilizer, house plant food, or large scale agricultural fertilizers must have N, K, and P for plants to thrive. Plants are the most important part of our diet, and increasing our production of plants is part of our challenge to feed a hungry world of over 7 billion people. We must use fertilizer wisely so that excessive amounts do not cause other environmental problems.

*Marilyn D. Duerst is a Retired Distinguished Lecturer in Chemistry from the University of Wisconsin-River Falls.*

# Keeping Apples Fresh!

By Alexa Silva

**H**ave you ever noticed that when you leave a slice of apple sitting out for a while, it develops brown spots? Can it be avoided? Some people think that keeping the apple slice immersed in water prevents those brown spots from developing. Others think that dipping the apple slice in lemon juice helps! Is any of it true? Let's investigate!

## Materials

- An apple
- Lemon juice
- Water
- Paper towels
- Plastic spoons
- 4 small bowls (paper or plastic, and able to hold ½ cup of liquid)
- Vinegar
- Cranberry juice
- Clock or timer
- Pencil and paper
- ½ cup measuring device



## Safety Suggestions

- ✓ Thoroughly wash hands after this activity
- ✓ Have a parent or adult assist with slicing the apple



## Procedures

1. Place five pieces of the paper towel next to each other. Using the pencil, label the first one “vinegar,” the second “lemon juice,” the third “cranberry juice,” and the fourth “water.” Label the fifth one “control.”
2. Place one small bowl on each one of the first four paper towels. The last paper towel will not have a bowl on it.
3. Prepare solutions for each of the bowls. You will need about ½ cup of each of the juices, just enough to cover the cut surface of the apple slice.
  - a. Pour about ½ cup (120 ml) of vinegar into the small bowl on the paper towel labeled “vinegar.”
  - b. Pour about ½ cup of lemon juice into the small bowl on the paper towel labeled “lemon juice.”
  - c. Pour about ½ cup of cranberry juice into the small bowl on the paper towel labeled “cranberry juice.”
  - d. Pour about ½ cup of water into the small bowl on the paper towel labeled “water.”
4. Ask your adult partner to cut the apple in slices for you. You will need at least 5 slices.
5. Place one slice of apple in each of the small bowls, and one on the paper towel labeled “control.”
6. Leave them there for 30 seconds.
7. Using the plastic spoons, remove the slices and place them on the corresponding paper towel.
8. Write down the current time, which will be your start time.
9. Check the apple slices every 30 minutes and write your observations in the table below. Your observations will answer questions to help you uncover a mystery! Are there some brown spots? A lot of brown spots? No brown spots? It is overall light brown? Dark brown? Half-covered? Completely covered? Be as specific as you can.
10. Based on the results you collected, answer the questions below:
  - a) Did dipping the slices of apple in a solution help to prevent them from turning brown?
  - b) Which solution was more effective in preventing the browning of the apple?



Time	Vinegar	Lemon juice	Cranberry juice	Water	Control
0 min					
30 min					
60 min					
90 min					
120 min					
150 min					
180 min					

## Understanding the browning of apples

It's all about the chemistry! When the apple is cut, substances called **enzymes** (such as polyphenol oxidase), contained in the plant tissue, are released. These enzymes will interact with the oxygen from the air and form new brown substances called **melanins**. This process works well at warm temperatures and when the pH is between 5 and 7. pH is a scale that measures whether something is an acid, a base, or neutral. Water is neutral and has a pH of 7.

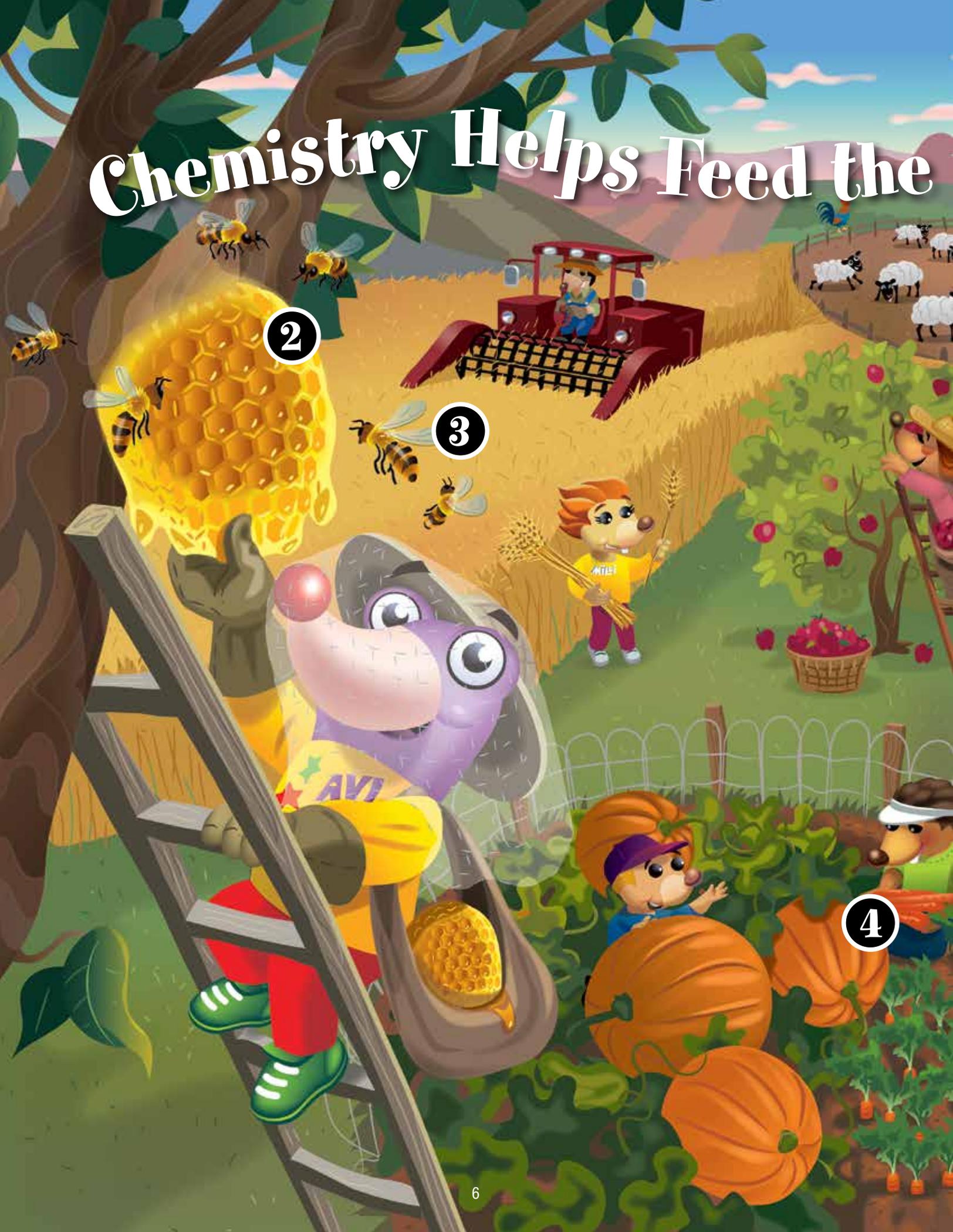
When the apple is dipped in solutions of low pHs, called acidic solutions, the enzymes do not work! So, looking back at your table, which solutions have the lowest pH? What is your evidence for your claim?

## References

Relationship between Apple Ripening and Browning: Changes in Polyphenol Content and Polyphenol Oxidase, Masatsune Murata, Mie Tsurutani, Masami Tomita, Seiichi Homma, Katsuyoshi Kaneko *J. Agric. Food Chem.*, **1995**, 43 (5), pp 1115–1121

*Alexa Silva is Director of Instruction and Outreach for the Department of Chemistry at Binghamton University, State University of New York.*

# Chemistry Helps Feed the



2

3

4

# World



**1** One glass of fortified milk provides 16% of your daily protein needs, and 30% of your daily need for calcium, a mineral that helps your bones and teeth stay healthy. Milk also has vitamin D, which is good for bone health, along with other minerals.

It takes 12 pounds of whole milk to make one gallon of ice cream, and 21.2 pounds to make one pound of butter!

**2** Honey is nature's oldest natural sweetener, and is mostly made of fructose, a simple sugar. Some of the vitamins and minerals in raw honey are vitamin C, calcium, and iron.

Raw honey also contains antioxidants that protect cells from being damaged by free radicals. Free radicals are compounds formed when our bodies convert the food we eat into energy.

**3** Bees are important for many kinds of crops. As they fly from flower to flower collecting pollen, honey bees pollinate everything from nuts to apples, cantaloupes, cranberries, pumpkins, and sunflowers.

**4** Carrots, pumpkins, and squash provide you with a lot of vitamin A, called retinol, which is good for your eyes' health. They are orange because they contain a colorant called beta-carotene.

**5** Apples are a member of the rose family of plants, along with pears, peaches, plums, and cherries. The science of apple growing is called pomology.

Apples are rich in antioxidants, dietary fiber, and vitamins C and B-complex. B-complex vitamins help keep your red blood cells and nervous system healthy.

Did you know it takes about 36 apples to create one gallon of apple cider ... and that 25 percent of an apple's volume is air?

# Chemistry of Honey – Why Doesn't Honey Spoil?

By George Fisher

**H**oney is older than you think. The first sign of humans harvesting honey was found in a drawing on the wall of a cave in Valencia, Spain ... drawn over 8,000 years ago! Archaeologists also found another clue: a honey comb that had been buried with pharaohs in a 3,000-year-old Egyptian tomb. The honey was preserved — and supposedly, it was still edible!

So, why doesn't honey spoil over time, like most other foods? The answer has to do with its chemical composition. Bees collect nectar from flowers, which is about 80% water and 20% sugars. **Enzymes** that bees make turn the complex **sucrose sugar** into the simple sugars called **fructose** and **glucose**, which produces a very watered-down honey. Bees store this liquid in their hives, and when the water evaporates, it leaves only the simple sugar, with very little water.

The low water content of honey is a key reason that it doesn't spoil. The water content of honey is so low that it won't allow bacteria to grow, which makes honey resistant to spoiling. Another thing that keeps honey from spoiling is its **acidity**. Honey's **pH** is around 4, due to some acids produced by the bee enzymes and the glucose molecules in the honey. This acidity also helps the honey fight bacteria, since bacteria grow best in neutral rather than acidic conditions. By the way, honey's antibacterial properties are strong enough for it to be an effective wound dressing, if no other antibacterial substance is around!

You might also notice that over time, honey begins to crystallize and solidify, thanks to its low water content. This isn't spoilage. The honey is still perfectly good to eat. To revert the honey back to its liquid form, all you have to do is heat it gently for a few minutes.

Hungry for more food and drink chemistry? Check out [www.compoundchem.com](http://www.compoundchem.com).

*George Fisher is a Professor of Chemistry at Barry University in Miami, Florida.*

## Word Search

Try to find the words listed below – they can be horizontal, vertical or diagonal, and read forward or backward!

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

**ACID**  
**BASE**  
**CARBOHYDRATE**  
**CASEIN**  
**ENZYME**  
**EUTROPHICATION**  
**MELANIN**  
**NITROGEN**  
**PHOSPHORUS**  
**POLYMER**  
**POTASSIUM**  
**STARCH**  
**SUCROSE**

For answers to the Word Search, please visit the Educational Resources page at [www.acs.org/earthday](http://www.acs.org/earthday).



# STARCH SEARCH!

By Richard Rogers

## Introduction

Starch is in many of the foods we eat, but not all. Starch is also found in regular paper, but not in the paper used to make currency. So, scientists created a special marking pen to see the difference between real money and counterfeit, or fake, money. The pen detects counterfeit money using a chemical that changes color when it is added to starch. The same pen will also help us detect starch in food products.

## Materials

- Counterfeit money detector pen (available at office supply stores)
- White printer paper
- Various food products (some suggestions below)
  - Potato chips
  - Apple
  - Flour tortilla
  - White bread
  - Radish
  - Other light-colored foods



## Procedures

1. Make a mark on the paper with the detector pen. Note the color change. It should change from yellow to dark purple/black, which indicates the presence of starch.
2. Repeat this process with the various food products. Record whether the color changes, indicating the presence of starch.
3. Keep the pen covered between tests to ensure accuracy of the test.



## Safety Suggestions

- ✓ Do not eat or drink any of the materials used in this activity
- ✓ Thoroughly wash hands after this activity
- ✓ Have a parent or adult assist

## How does it work? Where's the chemistry?

Starch is a very large carbohydrate molecule that twists into a helix. The detector pen fluid contains an indicator that becomes trapped in the helix and reacts to change color. Smaller carbohydrates like sugar are not big enough to trap the indicator, so they will not change color.

*Richard Rogers is a Senior Research Chemist at Grain Processing Corp.*



# The Adventures of Meg A. Mole, Future Chemist



**Dr. Victoria Finkenstadt,  
Lead Scientist, U.S. Department  
of Agriculture (USDA)**



**F**or Earth Day 2017, I traveled all the way to Peoria, Illinois to meet Dr. Victoria Finkenstadt. Dr. Finkenstadt is a Lead Scientist who directs research for the U.S. Department of Agriculture (USDA) at their National Center for Agricultural Utilization Research. “We fondly call it the Ag Lab,” she says with a laugh. That was a much easier name for me to remember!

So what does the team at the USDA Ag Lab do? Dr. Finkenstadt explained, “We use natural materials, grown in the United States, to make new plastic materials.” Her work includes research using plant-based polymers. I learned how this research is very important and needed for our environment. She continued, “With unstable petroleum prices, people are looking for alternatives that cost less but are also sustainable and friendly to the environment.”

I asked Dr. Finkenstadt, “What do you like most about your job?” She shared with me that she “loves learning new things, doing research with a purpose, and having independence for planning and executing programs.”

The day-to-day work in the Ag Lab has a lot of variety. Working in the laboratory only takes up about 15% of Dr. Finkenstadt’s schedule. In the lab, they work with “engineering equipment for plastics materials” ... and always remember to wear their safety glasses! The majority of her time (about 60%) is dedicated to planning and analysis/interpretation of data. She also spends some time writing for publications and managing her team.

So why did Dr. Finkenstadt go into science? While growing up, her family “played a lot of counting games and thinking games.” She came from a large family and remembers clearly that they “were always playing some sort of educational game devised by her parents.” However, after having a very good freshman chemistry teacher who always used demonstrations in class, she knew she wanted to be a chemist.

As I was getting ready to leave, I asked Dr. Finkenstadt one more question. “Where would a child come in contact with the work that you have done here in the Ag Lab?” She was very excited to share that she had worked for a few years on the take-home containers that we get from restaurants! So the next time you are at a restaurant and get your order “to go,” think about all of the science that Dr. Finkenstadt and her team did to create that box just for you!



## Personal Profile

**FAVORITE PASTIME/HOBBY?** Gardening and planting

**ACCOMPLISHMENT YOU ARE PROUD OF?**

Getting her doctorate

**VERY INTERESTING PROJECT YOU WERE A**

**PART OF?** Current bio-based anticorrosive project

**BIRTHDAY?** March 23

# Glue from Milk

By Marilyn D. Duerst and Richard Rogers

## Introduction

**M**ilk — it's nature's finest food! You know it comes from cows ... but did you ever wonder what it takes to produce that glass of milk you have with your meal?

Milk sold in stores comes from cows raised on dairy farms. So what is the daily menu for a cow? The average cow eats 20 lb. of hay, 20 lb. of corn silage, 10-20 lb. of corn, and 6-12 lb. of supplement (protein, vitamins and minerals). All this is washed down with 35 gallons of water. In return, the cow produces 6.2 gallons of milk (53 lb.) each day.

Milk provides your body with calcium and phosphorus for strong bones and teeth, protein for muscles, and some vitamins for good health. Besides being a great-tasting beverage, milk is used to make cheese, butter, yogurt, and ice cream. YUM! But did you know that you can also make glue from milk? Here's how.

## Materials

- Non-fat milk or skim milk
- Saucepan
- Access to a stove
- Measuring spoon and measuring cup
- Popsicle sticks or a wooden spoon for mixing the glue
- White vinegar
- Sodium bicarbonate (baking soda)
- A 4-ounce baby food jar (or similar container) with the label removed
- Small sieve



## Procedures

1. Put 2 cups (about .5 L) of milk into a saucepan. Add six tablespoons (about 90 ml) of white vinegar and stir.
2. Heat the contents of the saucepan on a stove using low heat. Stir continuously and watch closely for clumps to form. When they do, remove the saucepan from the heat.
3. These clumps mean that the milk is curdling.
4. Continue stirring until the curdling stops.
5. Remember the nursery rhyme about Little Miss Muffett? Well, now you have a pot of curds and whey! Pour the contents of the pot through a sieve, catching all the curds. The liquid portion, called whey, can be discarded down the sink. Caution: Hot liquid and contents!

## Safety Suggestions

- ✓ Safety goggles required
- ✓ Adult supervision and help required
- ✓ Protective clothing suggested
- ✓ Caution: hot liquids!
- ✓ Do not eat or drink any of the materials used in this activity
- ✓ Thoroughly wash hands after this activity

6. Transfer the curds to a cup or a small jar.
7. Add ¼ cup (about 60 ml) water and 1 tablespoon (15 ml) of sodium bicarbonate. Stir well. You may see small bubbles appear as the baking soda, a base, neutralizes the vinegar, an acid. The resulting product will be glue!
8. Place a label on the jar and mark it as "Glue."
9. Glue two pieces of paper using small amounts of mixture you made in the earlier steps and set them aside to dry. Once the glue is completely dry (roughly 5 minutes), you should find that the papers are permanently stuck together.

## How does it work? Where's the chemistry?

The clumps of curds you produced are a protein from milk called **casein**. Casein proteins make up 3% of whole milk. Elmer's Glue and other woodworking glues were originally made from casein, just like the glue you made. The Borden Company bought The Casein Company in 1929, and in 1932 introduced its first glue. Can you guess why Elsie the Cow is the mascot of the company? Today, the glue isn't made from casein anymore, but from a polymer called polyvinyl alcohol (PVA). But Elsie is still the mascot!

## References

<http://www.education.com/science-fair/article/glue-from-milk/>

*Marilyn D. Duerst is a Retired Distinguished Lecturer in Chemistry from the University of Wisconsin-River Falls, and Richard Rogers is a Senior Research Chemist at Grain Processing Corp.*

## Words to Know

**Acid:** a corrosive or sour-tasting substance such as lemon juice or vinegar, opposite of base. Acids have a lot of protons.

**Base:** a bitter-tasting or slippery-feeling substance such as baking soda or soap, opposite of acid. Bases have a lot of hydroxide ions.

**Carbohydrates:** natural polymers made up of carbon, hydrogen, and oxygen

**Casein:** protein from milk that clumps together when milk is heated

**Enzyme:** proteins that help chemical reactions happen, like breaking apart complex sugars or forming colorful substances.

**Eutrophication:** a form of water pollution when an abundance of phosphorus causes algae to grow rapidly in bodies of water, and results in competition between aquatic plants and animals for sunlight, space, and oxygen

**Hydroxide ion:** an oxygen and a hydrogen atom stuck together with one negative charge. Present in high amounts in bases.

**Starches and sugars:** carbohydrates that provide energy to the body when they are eaten and digested. Starches are very big, while sugars are smaller and have names that end with -ose (like glucose, sucrose, and fructose).

**Melanin:** brown substance created by the interaction of enzymes in cut apples and oxygen from the air

**N (nitrogen), K (potassium), and P (phosphorus):** elements used in most fertilizers

**pH:** a numeric scale (0-14) used to tell the acidity or basicity of a substance

**Proton:** a hydrogen with one positive charge on it. Present in high amounts in acids

**Polymer:** any molecule that is a chain of repeating parts, like how beads on a string can make a necklace. Polymers can be from plants, like the carbohydrates we eat, or made in laboratories, like the plastic we use in safety goggles.

**Sucrose:** a complex sugar that is made of one glucose molecule and one fructose molecule stuck together. Bees use enzymes to break sucrose apart to make honey.

## What is the American Chemical Society?

The American Chemical Society (ACS) is the largest scientific organization in the world. ACS members are mostly chemists, chemical engineers, and other professionals who work in chemistry or chemistry-related jobs. The ACS has nearly 157,000 members. ACS members live in the United States and different countries around the world. Members of the ACS share ideas with each other and learn about important discoveries in chemistry during scientific meetings held around the United States several times a year, through the use of the ACS website, and through the many peer-reviewed scientific journals the ACS publishes. The members of the ACS carry out many programs that help the public learn about chemistry. One of these programs is Chemists Celebrate Earth Day, held annually on April 22. Another of these programs is National Chemistry Week, held annually the fourth week of October. ACS members celebrate by holding events in schools, shopping malls, science museums, libraries, and even train stations! Activities at these events include carrying out chemistry investigations and participating in contests and games. If you'd like more information about these programs, please contact us at [outreach@acs.org](mailto:outreach@acs.org).

## Celebrating Chemistry

is a publication of the ACS Office of Science Outreach in conjunction with the Committee on Community Activities (CCA). The Office of Science Outreach is part of the ACS Division of Membership. The Chemists Celebrate Earth Day (CCED) edition of Celebrating Chemistry is published annually and is available free of charge through your local CCED Coordinator. CCED is a combined effort among CCA and several ACS Technical Divisions. Please visit [www.acs.org/cced](http://www.acs.org/cced) to learn more about CCED.

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