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International Year of  
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2011

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# Celebrating Chemistry

National Chemistry Week American Chemical Society

## Chemistry - Our Health, Our Future!



# Chemistry - Our Health, Our Future!

By Tracy Halmi

**C**hemistry is the study of **matter** and its properties; and health is the general condition of the body. What do these two areas of science have in common? EVERYTHING!!!! Our health and well-being are directly related to chemistry.

Let's start with water. Your body is made up of almost 60% water. Water is very important for humans to be healthy, and it is a chemical. Water is composed of two hydrogen atoms and one oxygen atom. **Atoms** are the building blocks of all matter, including your body.

What other chemicals do we need to be healthy? Vitamins and minerals are important chemicals that our bodies need. Vitamins are necessary for growth and digestion, and for our nervous system. It is recommended that kids 9–13 years old eat 45 **milligrams** of vitamin C per day. That is equal to eating one orange or two servings of broccoli. **Vitamins** are big molecules made up of mostly carbon and hydrogen atoms.

Minerals contain atoms like iron. Yes—kids need iron to stay healthy. The body uses iron to help transport oxygen in the blood to all parts of the body. Kids should eat 8 milligrams of iron per day, which is the amount found in four beef (3 oz) hamburgers.

Although we need iron, would it be healthy to eat four hamburgers in one day? No. Even though there is a lot of iron in beef, there are also a lot of calories from fat. Turkey is a good alternative to beef and contains just as much iron.

Our body needs some fat to stay healthy, but too much fat can make us sick. In fact, eating too much food of any kind can make us too heavy. When kids or adults are too heavy for their height, they have a condition called **obesity**. Obesity is caused by too much body fat. Too much body fat can lead to problems such as an unhealthy heart.

In addition to eating well, one way to stay healthy is to avoid germs that can make us sick. Did you know the best way to keep germs away is to wash your hands? Soap and water wash away germs and stop them from getting inside our bodies where they can make us sick.



But sometimes, we do get sick. When people become sick, chemicals can help make us better. Did you know medicines are chemicals too? Medicines can keep a fever down or stop a headache. Some medicines (antibiotics) fight bacteria that make us sick. Other medicines help people fight disease. Scientists discover new medicines each year to help people live healthy, long lives.

In this edition of *Celebrating Chemistry*, we explore how chemistry is related to our health. Read on to learn more about how chemistry keeps us healthy!



# Washing Hands - The First Line of Defense

By Robert Yokley

## What?

Germs are organisms that are very tiny and sneaky. They can creep into our bodies and make us sick or cause serious disease. The four major types of germs are bacteria, viruses, fungi, and protozoa. Some bacteria can cause infections, sore throats, cavities, and pneumonia. Viruses can cause colds, flu, chickenpox, and measles. Fungi can cause rashes such as athlete's foot. Protozoa can cause diarrhea (runny poop).

## Why?

Germs are everywhere: in the refrigerator, in food, on surfaces such as toys and floor, and even on your pets. Every object, person, or animal has germs. It isn't that germs somehow seep into our skin. The problem is when we get germs on our hands, we then put our hands in our mouths, eyes, and noses; and they enter our bodies. Washing your hands can kill germs before they enter your body and make you sick. Handwashing is your first line of defense. Did you know that a single germ can grow into more than 8 million germs in just one day? When someone sneezes, germs can travel across a room at 80 miles per hour!



## When?

Always wash your hands before:

- Preparing food
- Eating
- Treating wounds, giving medicine, or touching a sick or injured person
- Inserting or removing contact lenses
- Touching a baby

Always wash your hands after:

- Preparing food (especially raw meat and poultry)
- Using the toilet
- Handling money
- Touching an animal or animal toys, leashes or waste
- Blowing your nose
- Treating wounds, giving medicine, or touching a sick or injured person

## How?

These hand washing instructions are provided by the Centers for Disease Control and Prevention:

- Wet your hands with warm, running water, apply soap, and lather well.
- Rub your hands together for 15–20 seconds.
- Don't forget to rub all surfaces, including between each finger, the backs of your hands, your wrists, and fingernails.
- Rinse all soap off your hands.
- Dry your hands completely with either a clean towel or disposable towel.
- If in a public restroom, turn off the faucet with your disposable towel.

\*Adapted from <http://www.earthskids.com> and <http://kidshealth.org>



# Wash This Way!

**W**hen you wash your hands, how do you do it? With soap and water? With water alone? Do you scrub your hands, or simply rinse them under the faucet? Does it even matter? Yes, it does!

**Be sure to follow Milli's Safety Tips, and do this activity with an adult! Safety goggles are required.**

## YOU WILL NEED:

- Non-stick cooking spray
- Ultra-fine glitter
- Timer or watch with a second hand
- Access to a sink with warm and cold water, soap, and paper towels
- Data sheet (Draw 8 small outlines of hands on a sheet of paper)
- Four helpers

## WHAT YOU WILL DO:

1. Have each helper "dirty" their hands as follows:
  - a. Coat hands lightly with nonstick cooking spray. Spray over a sink or newspaper because the floor will get very slippery if the spray gets on the floor. Rub hands together to thoroughly coat the front and back of the hands and between all fingers.
  - b. Sprinkle one hand with glitter, and rub the hands together to cover the front, back, and fingers of both
2. Have the helpers wash their hands as follows:
  - a. Helper 1: Wash with warm water, rinsing only (no scrubbing or soap) for 5 seconds.
  - b. Helper 2: Wash with warm water, scrubbing for 20 seconds under the faucet without using soap.
  - c. Helper 3: Wash with warm water and soap, scrubbing hands (while not under the faucet) for 5 seconds, and rinsing just until no soap is left on the hands.
  - d. Helper 4: Wash with warm water and soap, scrubbing hands (while not under the faucet) for 20 seconds, and rinsing just until no soap is left on the hands.
3. Observe the cleanliness of each helper's hands. Record observations on the data sheet by shading in the outline of a hand to indicate where you still see glitter.
4. Tell each helper to dry their hands thoroughly with a paper towel. Again, observe and record the cleanliness of each helper's hands.
5. Once you've recorded all observations, have all the helpers completely wash up with soap and water to remove all glitter and cooking spray.

hands. The glitter represents germs typically found on our hands.



## QUESTIONS TO CONSIDER:

- Which helper used the hand-washing technique that you normally use or that you think most people use?
- Which hand-washing method was the most effective? Which was the least effective?
- What factor do you think is most important in hand washing?

## WHAT YOU WILL DISCOVER:

The ultra-fine glitter serves as a visual reminder of the germs found on our hands, although the glitter is much bigger than germs. Germs can be harmful because they can cause disease or infection, but other microorganisms (such as some bacteria) found on our hands are harmless.

Unfortunately, some people rarely wash their hands and, of those who do, most overestimate how thoroughly they do it.

**Proper hand washing tips** are provided on page 3.

This activity was adapted from "Wash This Way", Terrific Science, Miami University, Ohio. [http://www.terrificscience.org/downloads/health\\_science/Why\\_Wash.pdf](http://www.terrificscience.org/downloads/health_science/Why_Wash.pdf)

## 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!





# The Adventures of Meg A. Mole, Future Chemist

## Meg celebrates the International Year of Chemistry 2011 and Interviews Valory Trumpy Hill, MD

where kids come to see her for their scheduled appointments. She told me that she “hopes to have a positive influence on their lives as they grow, and teach them how to be as healthy as they can be.”

She was definitely interested in science growing up. She told me that “her father is an engineer and he loved to help throughout the years with science projects”. She also had the “best science teachers who made learning fun”. Her favorite subjects were chemistry, biology, and math. She decided to go into science because she “loved figuring out how things worked and being able to be hands-on with learning.”

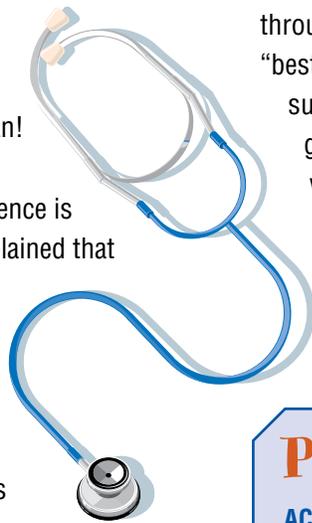
The next time you go to the doctor, remember that medicine is another neat career that you can go into by studying science!

**T**o learn a little more about medicine and staying well, I made a trip to Annapolis, Maryland. Here I met Valory Trumpy Hill, MD. She is a pediatrician!

I know all about going to the doctor for check-ups, and it was great to learn that science is a big part of being a doctor too! Dr. Hill explained that she “takes care of children from birth to 18 years old”. She also said that her “goal is to help them grow up safe and healthy”. She also helps them “feel better when they are sick or broken”.

So what tools do pediatricians use besides medicine? She told me the “most important tools that I use every day are my stethoscope and otoscope”. Her stethoscope was my favorite! It looked like a necklace, and she showed me how to use it to listen to someone’s heart and lungs. I could hear the heart beating and the person breathing! The otoscope was neat too! She uses it to look into her patients’ ears to make sure they are also healthy.

Dr. Hill told me the best part of her job is that she “loves working every day with infants, children, and their families. It is so rewarding to watch them grow up and help them feel better when they are sick”. She gets to work in a hospital, where she “examines newborn babies”, and in her office,



### Personal Profile

#### ACCOMPLISHMENT YOU ARE PROUD OF?

Being the mom of two beautiful children and completing a full marathon.

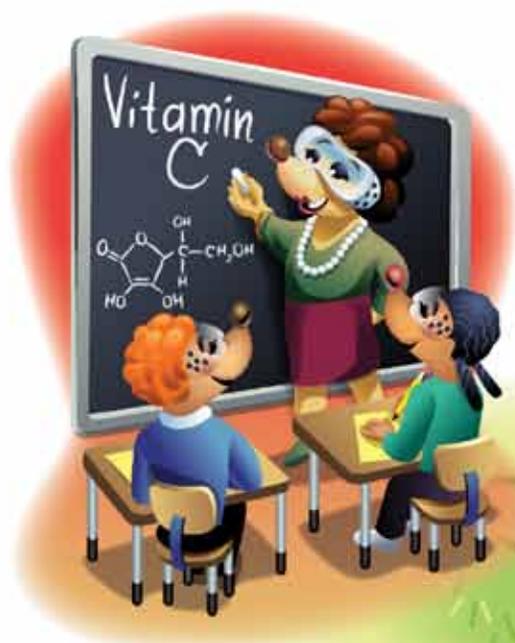
**BIRTH DATE?** October 6

**ABOUT YOUR FAMILY?** I have been married for 16 years to a police officer. We have an 11 year old daughter who loves to dance, an 8 year old son who is an amazing baseball player. We all love to snow ski and bike ride together as a family. I am also proud to say that both kids love math and science!



# Chemistry

By Tracy Halmi



## 1. Vitamins and minerals

**Vitamins and minerals also keep us healthy.** Vitamins are big molecules made mostly of carbon and hydrogen atoms. Vitamin C is necessary for growth and quickens the body's ability to repair wounds. Great sources of vitamin C are berries, broccoli, citrus fruits, mango, spinach, and tomatoes.



## 2. Healthy Weight

Obesity is when a person weighs too much for their height. Almost 20%, that is one out of every five children in the United States, are considered obese. In most cases, obesity is caused by eating too much and exercising too little. As we grow, obesity can create problems with blood pressure as well as lead to high levels of sugar and cholesterol in the blood. The best way to avoid obesity is to eat healthy foods and exercise.



# for Health



## 3. Physical Activity

Physical activity not only burns calories, but also builds strong bones and muscles. It also helps you sleep well at night and stay alert during the day.

Other ways to be active are:

- **Limit TV, computer, and electronic game time to no more than two hours a day.**
- **Play—don't exercise.** Don't make exercise a chore. Have fun with games and sports you like.
- **Find active activities that you enjoy, like riding a bike.**

Check out [www.letsmove.gov](http://www.letsmove.gov) for more information on physical activity.

## 4. Healthy Eating

Healthy eating choices make it easier to maintain a healthy weight. Here are a few tips.

- **Eat more fruits and vegetables.** Fruits and vegetables provide more than just **calories**; they give you **vitamins** and **minerals** needed for growth.
- **Limit sweetened beverages**, even those containing fruit juice. They are high in calories but low in vitamins and minerals.
- **Eat balanced meals**, choosing from each of the food groups.

Check out [www.choosemyplate.gov](http://www.choosemyplate.gov) for more information on food and nutrition.



# Testing Vitamin C- Chemistry's Clear Solution

**W**hich has more vitamin C: Tang® drink mix or orange juice? Chemistry and color can help you find the answer.

Be sure to follow Milli's Safety Tips, and do this activity with an adult! Safety goggles are required.



**CAUTION**

*Be careful when using tincture of iodine. Read and follow all directions on the label. Use in a well-ventilated area. Collect all iodine waste and dispose according to local regulations. When you have finished the activity, rinse out all cups and throw them away. Work with an adult.*

**DO NOT DRINK ANY SOLUTIONS OR TASTE THE VITAMIN C TABLET!**



## YOU WILL NEED

- 4 Starch pellets (biodegradable starch “packing peanuts” available at mailing supply stores).
- Water
- Coffee filter
- Tang® breakfast drink (or your favorite vitamin C-fortified drink)
- 1 Vitamin C tablet
- Tincture of iodine solution or Betadine
- Plastic cups (two 8-oz and six 3-oz)
- Set of Measuring spoons
- Dropper
- Orange juice (not fortified)
- Measuring cup (½ cup)
- Marker pen

## PROCEDURE

- 1.** Make a solution by adding 1 teaspoon of tincture of iodine to 1 tablespoon of water.
- 2.** Use the two 8-oz cups to make your starch solution: Dissolve 4 starch pellets in ½ cup of water. Set up a coffee filter in the other cup. Pour the starch solution through the filter. Label this cup “**starch solution**”.
- 3.** Label three of the 3-oz plastic cups “**vitamin C test**”, “**Tang® test**”, and “**orange juice test**” as shown below. Add 1 tablespoon of starch solution to each cup.
- 4.** Now add 1 drop of the iodine solution to each labeled test cup. What color does the liquid in each cup turn?



## Prepare your test solutions

5. Label a fourth 3-oz cup “**vitamin C solution**”. Crush the vitamin C tablet, and put it in the cup with 2 tablespoons of water. Stir.
6. Make your Tang® by mixing  $\frac{3}{4}$  teaspoon of powder to 2 tablespoons of water in a 3-oz cup you have labeled “**Tang® drink**”. Stir.
7. Label your last 3-oz cup “**orange juice**”, and pour 2 tablespoons of orange juice into it.

## Time to test

8. Fill your dropper with vitamin C solution, and add 1 drop into the cup marked “vitamin C test” and swirl. Observe what happens. Count how many drops of vitamin C solution you have to add to the cup to make the contents of the cup turn colorless. Record this amount in the table. This shows you how vitamin C affects the starch/iodine solution. Rinse the dropper with water before the next use.
9. Now, see how many drops of Tang® it takes to remove the color from the iodine/starch solution in your cup marked “**Tang® test**”. Record your results. Rinse the dropper with water again.
10. Do the same test using orange juice in the cup marked “**orange juice test**”. Record your results.

Item	Drops of Vitamin C Added
Vitamin C Test	
Tang® Test	
Orange Juice Test	

## Analyze your results

Look at your data table. Compare the number of drops it took for each solution to turn colorless. Can you use this information to say which solution, Tang® or orange juice, contains more vitamin C?

**Hint:** Remember the vitamin C solution contained the most vitamin C.

## Challenge

Try testing some other drinks such as orange soda pop, lemon-lime soda pop, cranberry juice, or apple juice for vitamin C.



## Where's the Chemistry

In this investigation, you observed color changes to determine the relative amounts of vitamin C in various test solutions. As you saw in step 4, when iodine reacts with starch, the iodine/starch mixture becomes a dark blue. However, when vitamin C reacts with iodine, the iodine changes to another form that doesn't turn starch blue. By adding drops of a test solution that contains vitamin C (vitamin C tablet, Tang®, or orange juice) to the cups of iodine/starch mixture, you are changing the iodine to the form that does not turn starch blue. When the blue color disappears, you know that all the iodine has been changed to this new substance. The more vitamin C a test solution contains, the fewer drops it takes to change all of the iodine and make the solution colorless. So, the test solution that required the fewest drops had the most vitamin C, and the test solution that required the most drops had the least vitamin C.



# Medicines

By Anne Taylor

## What are medicines and where do they come from?

You have an earache and a fever. Your mom takes you to the doctor who checks your temperature, ears, heart, and other things. The doctor says you have an ear infection and need some medicine to help with the infection, fever, and pain. You take the medicine and in a few days, you feel much better.

Medicine is a chemical substance that is used to make you feel better when you are sick. *A chemical substance?* Isn't that something bad? Not necessarily! Some chemical substances make you feel bad, but others make you feel good. A useful chemical substance is mixed with other ingredients to make a medicine. Medicine may come in different forms such as a tablet, syrup, injection (shot), or a cream.

The first medicines were made from plants. Ancient people discovered that certain plant materials could relieve pain or settle an upset stomach. It was later found that these plant materials contain chemical substances that are responsible for making you feel better. These chemical substances are called active ingredients. Chemists and other scientists found ways to make those chemical substances by using a series of reactions. This is called *chemical synthesis*. By this process, the chemical substances needed for a medicine can be produced in large quantities in a factory which makes it available to more people.



## Word Search

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

ATOM  
BODY  
CHEMISTRY  
EXERCISE

FRUITS  
GERMS  
HEALTH  
MEDICINE

MINERALS  
OBESITY  
SANITIZER  
SOAP

VEGETABLES  
VITAMIN  
WATER



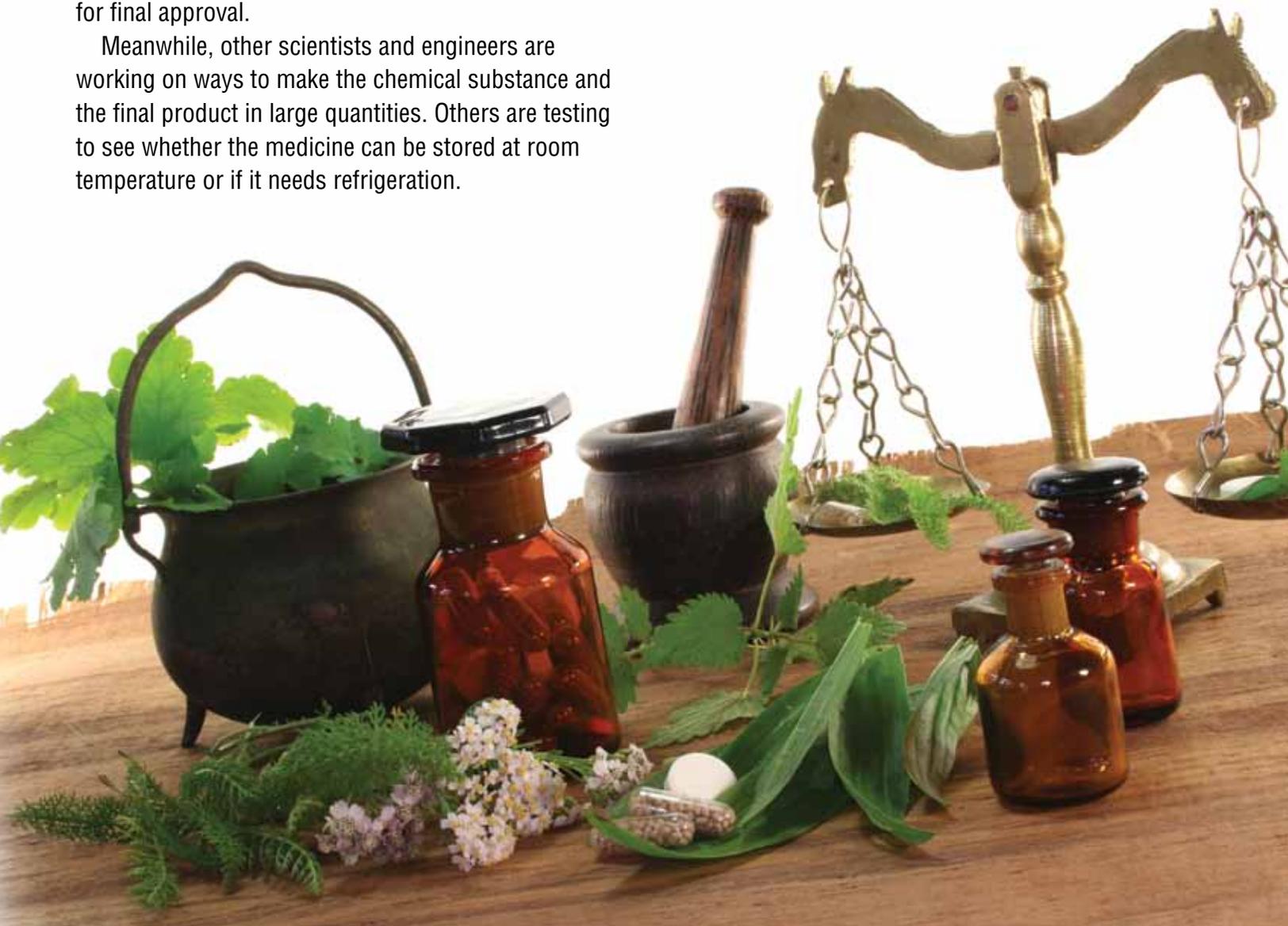
## How are new medicines discovered and developed?

Do doctors give the new drug to patients right away? No way! First, scientists must prove that it helps treat the disease and that it is safe. Before it is tested on humans, it is tested on small animals, such as mice or rats. If it is safe and effective, it may be tested on larger animals. If the results of these new tests are favorable, the company asks the Food and Drug Administration (FDA) for permission to try the medicine on humans. If the FDA approves, many tests on humans follow. If the tests on humans show that the drug works and is safe, the company asks the FDA for final approval.

Meanwhile, other scientists and engineers are working on ways to make the chemical substance and the final product in large quantities. Others are testing to see whether the medicine can be stored at room temperature or if it needs refrigeration.

It takes about 10 years before a new drug is ready for general use. Of all the proposed drugs, very few are safe and effective enough to win final approval, so that the company can sell them.

**Note:** All medicines are drugs, but not all drugs are medicines. The word drug also includes illegal substances that can hurt you. We used the word medicine in this article to distinguish between the good and bad drugs.



## Words to Know

**Atoms:** Tiny particles that make up all matter.

**Bacteria:** One-celled creatures that get their food from their environment.

**Fungi:** Plant-like creatures that can't make their own food.

**Germ:** Tiny living things that include bacteria, fungi, protozoa, and virus that are so small you need a microscope to see them. They can invade plants, animals, and people and some of them make us sick.

**Matter:** Anything that occupies space and has mass.

**Milligrams:** A very small measurement of mass. It takes 1000 milligrams to equal 1 gram.

**Obesity:** When a person is too heavy for their height.

**Protozoa:** A one-cell creature that lives in water or in moist places.

**Virus:** Tiny creatures that cannot live long outside a living thing. Viruses can cause diseases and make you sick.

## Celebrating Chemistry

is a publication of the ACS Department of Volunteer Support in conjunction with the Committee on Community Activities. The Department of Volunteer Support is part of the ACS Division of Membership and Scientific Advancement. Four editions of Celebrating Chemistry will be available for the 2011 celebration of the International Year of Chemistry ([www.acs.org/iyc2011](http://www.acs.org/iyc2011)). Limited copies are available free of charge through your local section's Chemists Celebrate Earth Day and National Chemistry Week Coordinators.



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## 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 more than 161,000 members. Most ACS members live in the United States, but some live in different countries around the world. Members of the ACS share ideas with each other and learn about important discoveries in chemistry during meetings that the ACS holds around the United States several times a year, through the use of the ACS website, and through the 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)!

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*The activities described in this publication are intended for elementary school children under the direct supervision of adults. The American Chemical Society cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from not specifically following directions, or from ignoring the cautions contained in the text.*