ACS
Chemistry for Life™

Celebrating Chemistry

Air–The Sky's the Limit!

CHEMISTS CELEBRATE EARTH DAY APRIL 22ND

AMERICAN CHEMICAL SOCIETY

Wind Energy: The Electricity Source That Never Runs Out and Doesn't Pollute

Wind power is everywhere, it seems—especially in television commercials. Have you seen some of the advertisements, maybe when you watched the Olympics last summer?

The machines that produce wind power look a little like the old-fashioned wind mills, but even more like airplane propellers. They are many times larger than propellers, though; they sit on top of steel towers with turning blades that are even taller than the Statue of Liberty. The blades are made of a high-tech material that is both strong and light so that the wind can easily turn them. Modern wind mills are called **wind turbines**. Wind turbines make electricity from the wind.

Understanding Wind Power

To understand how wind power works and how it helps the environment, it's helpful to know how electricity is produced using other kinds of energy. Older forms of electricity generation require fuel such as coal to be burned to heat water so that it turns into steam. Next, the steam makes the blades in a turbine spin around, much like how steam can push open a tea kettle's spout to make it whistle. The spinning blades produce energy, and they are connected to a machine called a generator. The generator stores the energy as electricity.

Wind power works much the same way, except that the only fuel it uses is the wind to turn the blades. In other words, it skips the burning part, so there is no pollution.

Why Wind Power Helps the Earth

Wind power offers many benefits. First, while the earth will eventually run out of fuels to burn, it will never run out of wind. That's why wind power is called a **renewable energy** source: as soon as you use it to make electricity, more of it comes along.

Second, wind power does not need any water (in the form of steam) to make its turbine blades turn, so it saves a lot of water that can be better used for other purposes, like drinking it.

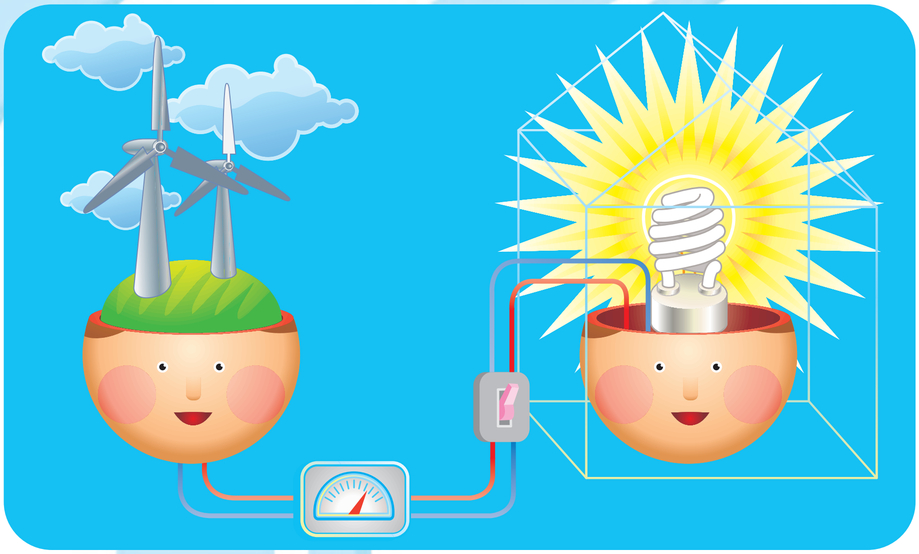
Third, wind energy has **zero emissions**. This means that, unlike coal and gas, wind energy makes a lot of electricity without putting any pollution into the air.

By October of 2008, there were over 21,000 megawatts of wind energy produced in the United States. A megawatt is a unit that measures energy potential. Most light bulbs, as you may already know, are between 25 and 100 watts. One megawatt is equal to 1 million watts.

So exactly how much power is 21,000 megawatts? One megawatt of wind power can provide enough electricity for 250 and 300 homes. Therefore, 25,000 mega-watts can provide enough electricity for 7 million homes.

Using all that wind power instead of burning other fuels to make electricity cuts down on the pollution that causes global warming. In fact, using 21,000 megawatts of wind power in the United States to reduce pollution is just like taking more than 6 million cars off our roads. It also saves over 18 billion gallons of water every year. That's an awful lot of extra water for us to drink.

AWEA AMERICAN WIND ENERGY ASSOCIATION



Pop Rockets

One important characteristic of a gas is pressure. Increasing the amount of gas in a container can raise the pressure of a gas. In this activity, you will use the build-up of pressure of a gas to launch a film-canister rocket.

Materials

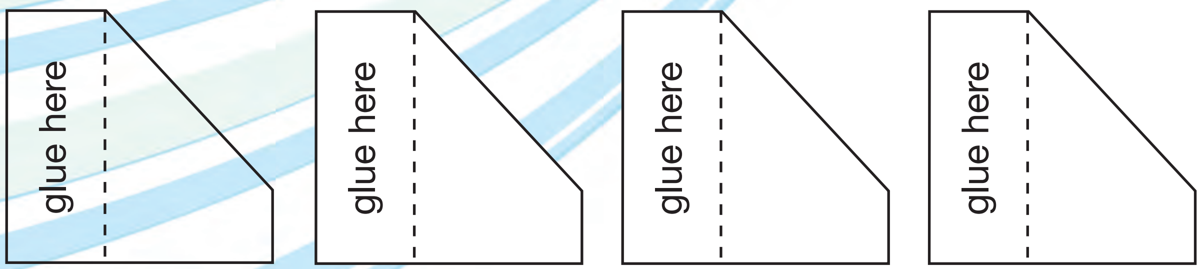
- File folder or card stock
- Blunt-end scissors
- Glue
- Empty film canister
- Double-sided tape
- Half of an effervescent antacid tablet
- Water

SAFETY! *Be sure to follow Milli's Safety Tips and do this activity with an adult! Do not eat or drink the water used in this activity!*

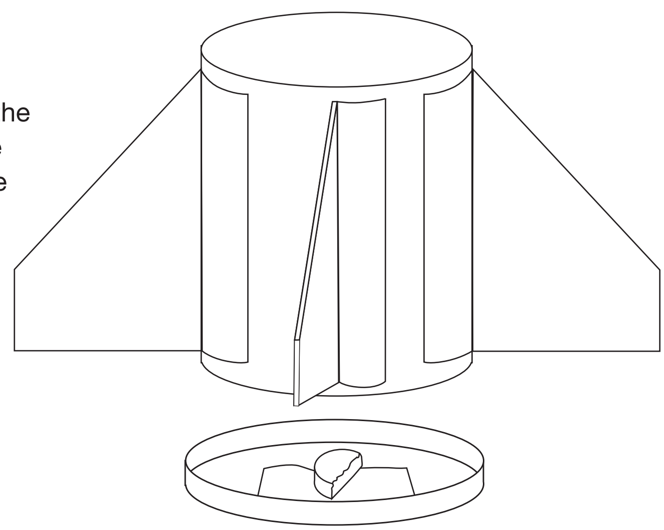
NOTE: *This activity can be messy and is best conducted outside.*

Procedure

Build the Rocket:



1. To make fins for the rocket, trace the patterns here onto a file folder or a piece of card stock (like a cereal box).
2. Cut along the solid lines so that you make four fins.
3. Fold the fins along the dotted lines.
4. Place glue on each of the fins in the area marked "glue here" in the picture above, and attach each of the fins to the film canister. Be sure to have the top of the triangle towards the closed end of the canister and to leave enough room to put the lid on the open end of the canister.
5. Fold the fins so they stick out from the canister.



Fuel the Rocket

1. Go outside or select an appropriate indoor area for the launch of your rocket.
2. Fill the canister half full of water.
3. Tape the half tablet of the effervescent antacid inside the lid of the canister using a piece of double-sided tape. Seal the canister and shake two or three times.
4. Quickly place the sealed canister on the launch area with the lid at the bottom and take at least 5–8 big steps backwards.
5. The tablet should produce enough gas in the canister to pop off its lid, which will propel the rocket into the air.
6. Dissolve any pieces of the effervescent tablets by placing them in a bowl of water. Thoroughly clean the work area and wash your hands.

Where's the Chemistry?

Effervescent antacid tablets contain an acid and a base, similar to baking powder. When the acid and base are dry, they do not react, but when they dissolve in the water, they react to produce carbon dioxide gas. As the gas is formed, pressure builds up until finally, the cap is blown off the canister.

CAUTION! ***Chemical protective goggles should be worn when performing this activity. The bottle top may fly in any direction, so keep a safe distance (5–8 large steps) from the rocket.***

The Adventures of Meg A. Mole, Future Chemist

Meg Interviews chemist Kate Boggiano

This year's Earth Day theme, "The Sky's the Limit", is also very true when it comes to careers in chemistry. For this year's Chemists Celebrate Earth Day celebration, I traveled all the way to Pennsylvania! I met Mary Kate Boggiano, a chemist with Armstrong World Industries.

Ms. Boggiano makes new adhesives and coatings for floors. Adhesive is another name for glue, and coatings are used to protect things. The coatings she makes are used to protect floors. This is like wearing a lab coat to protect my clothes, but the coatings she makes are created to stay on all the time. Ms. Boggiano investigates different coatings and adhesives to see whether a material already exists and then researches to see if it will work on the flooring. Not all coatings and adhesives work the same. For example, some floors are made of wood and others are made of plastics or other materials. Coatings and adhesives react differently to different materials, so she works to find the best ones for each need.

In the lab, Ms. Boggiano formulates (makes) new materials that she thinks will make good coatings and adhesives. She also tests them for different things like stickiness, discoloration, hardness, and other properties that affect how they will last and look. When working with chemicals, she always wears her safety goggles (like me) and never works alone!

One of the important things in designing floor coatings and adhesives is to make sure they contain no (or low) volatiles. Volatiles are chemicals that vaporize, or go into the air. Fewer of these chemicals means the air will be healthier to breathe and is much safer for the atmosphere.

I asked Ms. Boggiano if she liked science when she was growing up. She said she has "always been fascinated with learning how materials and technologies work." She also told me she was "very fortunate to have family and friends who encouraged her to be curious about the world around her." In school, although she says she did better in math than chemistry, she thought that, "chemistry is more fun because chemical reactions are everywhere in life. Understanding why chemical reactions happen and sharing that with others helps everyone to understand and take care of our world."

So where is Ms. Boggiano's work seen by kids? Everywhere! It can be found in the classroom, hallways, or even in the gym. You may be walking on or playing basketball on an Armstrong floor. In stores, restaurants, or at the dentist's office, you may find their floors too! At home, Armstrong vinyl and linoleum is probably in your kitchen and bathrooms. If you have wooden floors, they could be made by Armstrong.

The coatings she develops are the neatest thing I learned about her work. They are made so that it's easier to take care of the floors. She says, "This is important if someone were to color the floor with crayons or roller skate in the house." And everyone knows that Meg loves to color and roller skate!

To read more about my visit with Ms. Boggiano, visit www.acs.org/kids

Personal Profile: Mary Kate Boggiano

What is your favorite food? Crab!
When is your birthday? February 12th
Favorite pastime? Kayaking and hiking
What is an accomplishment you are proud of? I hiked across the Grand Canyon.
About your family: My fiancé and I live with our cat, Chester, and our dog, Buttercup.

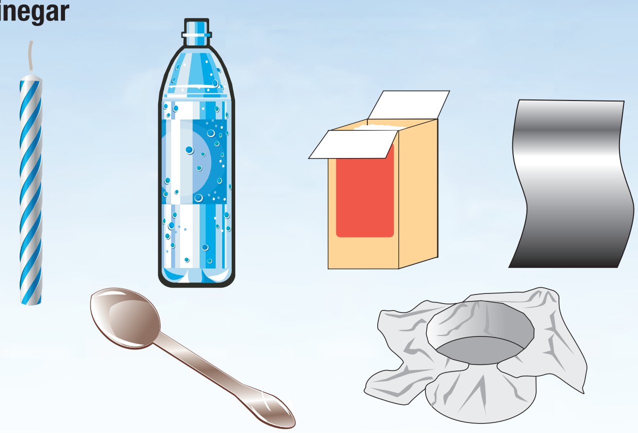
Pour CO_2

Introduction

Have you ever tried to blow out a candle? Maybe you or someone you know has been out of breath after trying. In this activity, you will use carbon dioxide that is found in your breath to blow out a candle. You will see that you can still have the excitement of blowing out a candle, but without being tired afterwards!

Materials

- **Birthday candle**
- **Foil cupcake wrapper or sheet of aluminum foil**
- **Vinegar**
- **1-liter (L) soda bottle (empty)**
- **Baking soda**
- **Teaspoon (tsp)**



CAUTION! ***Chemical protective goggles should be worn when performing this activity.***

Procedure

Make a candle holder by first poking a hole in the cupcake wrapper or aluminum foil. Then cut the bottom of a birthday candle so that the top of the wick is still below the rim of the holder, and adjust as needed.

Pour 1/3 cup vinegar into the 1-L bottle. Although the bottle contains a little liquid, it is mostly filled with the gases that make up air. Now you are going to put out a candle by "pouring" the gas (not the liquid) from the bottle.

1. Light the birthday candle.
2. Tilt the bottle letting a few drops of vinegar fall into the cup (but not on the flame). What happens now?
3. Put 1 tsp of baking soda into the bottle containing the vinegar. (You may want to use a funnel or paper cone to help you pour.) What do you observe?
4. Swirl the bottle to make sure the liquid and powder are mixed. When the fizzing dies down, tilt the bottle over the lighted candle, just as you did before. What happens? (You may need to keep pouring until a few drops of liquid fall into the foil cup, but don't pour the liquid onto the burning candle.)

Where's the Chemistry?

Carbon dioxide (CO_2) is a nonflammable gas. It can be poured downward through the air and collected in the aluminum foil cup where the candle sits because CO_2 is denser (heavier) than the air. As CO_2 collects in the cup, the air in the cup is pushed up and out by the denser CO_2 gas. As CO_2 collects around the flame, the flame loses its oxygen supply and goes out.

What did you observe?

Which direction did the carbon dioxide go when you poured it, up or down?
Why did it move in that direction?

Ask Yourself...

Is it possible that carbon dioxide can be poured?
Can other gases be poured?
Don't all gases fly away into the atmosphere?

You Can be a Chemist

Chemistry is the science that helps us learn about the world around us. Everything is made of chemicals—our bodies, our pets, our houses, the toys we play with, the medicines we take, the food we eat, and the books we read. Chemicals are the ingredients that make up all living and non-living things.

Chemists are scientists. Many of them work in laboratories to solve problems and make new materials. Laboratory chemists are often inventors. They combine chemicals in ways that no one else has done before. For example, chemists have discovered the adhesive used on Post-it notes, artificial sweeteners, Teflon, Nylon, new medicines, and many different kinds of plastics.

Some chemists are teachers. They help students learn about the world around them. Some chemists work for toy companies looking for more ways to keep children around the world entertained. Other chemists are lawyers or writers for newspapers and magazines. Because chemistry is part of everything, chemists work in many different fields and have a wide variety of jobs.

If you want to learn more about chemistry, watch your newspaper for notices about programs for K–12 students. Local colleges frequently sponsor programs for students with an interest in science. Your school guidance counselor or science teacher can also talk to you about these programs as well as some possible careers in chemistry. The work of chemists will never be over. As long as we need new products, better ways to protect the environment, and more information about the world and the way it works, there will be a need for chemists. For articles and other information about chemistry, check out **www.acs.org/kids.**

What is Green Chemistry?

Green chemistry has many connections to the air around us. Here are just a few examples.

Greenhouse gases in the atmosphere are a big concern because they cause global **climate change**. Green chemists discover alternative chemicals and processes that do not produce greenhouse gases.

Humans have used the wind's energy for thousands of years. Using moving air as a source of power is also an important way to produce clean energy. **Windmills** and wind machines can take wind energy and change it into electricity without releasing greenhouse gases into the air.

Green chemistry is pollution prevention at the source. Some examples of ways to practice green chemistry are creating more air-friendly fuels for cars, and improving the processes at chemical plants and power plants to prevent air pollution.

Buildings, schools, and even houses can create both indoor and outdoor air pollution. A green building has cleaner air both inside and out, because it is made with products that are low in **volatile organic compounds (VOCs).** Longer-lasting building materials and VOC-free paints, flooring, and furniture are now available.

In the future, you might drive in an electric car that is powered by batteries (that can be recharged by wind-produced electricity). Unlike gasoline-powered cars, electric cars do not produce carbon dioxide, (one of the greenhouse gases causing global climate change). These cars will also be greener if they are made from renewable materials and are completely recyclable or **biodegradable.**

Chemists can use air for a kind of chemical reaction called an **oxidation reaction.** Air is a lot safer and "greener" than alternative oxidizers. You see a "green" oxidation reaction every time you bite into an apple and it turns brown!

Air–The Sky's the Limit!

WORD SEARCH

G	F	P	S	Y	Y	G	T	B	N	X	Z	N	P	B	A	I	R	L	G
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OZONE DEPLETION
CLIMATE CHANGE
ZERO EMISSIONS
WIND POWER
WIND TURBINES
RECYCLE

BIODEGRADABLE
SUSTAINABILITY
CONSERVATION
RENEWABLE ENERGY
HAZARDOUS WASTE

CARBON DIOXIDE
GREENHOUSE GASES
WIND ENERGY
EARTH DAY
AIR

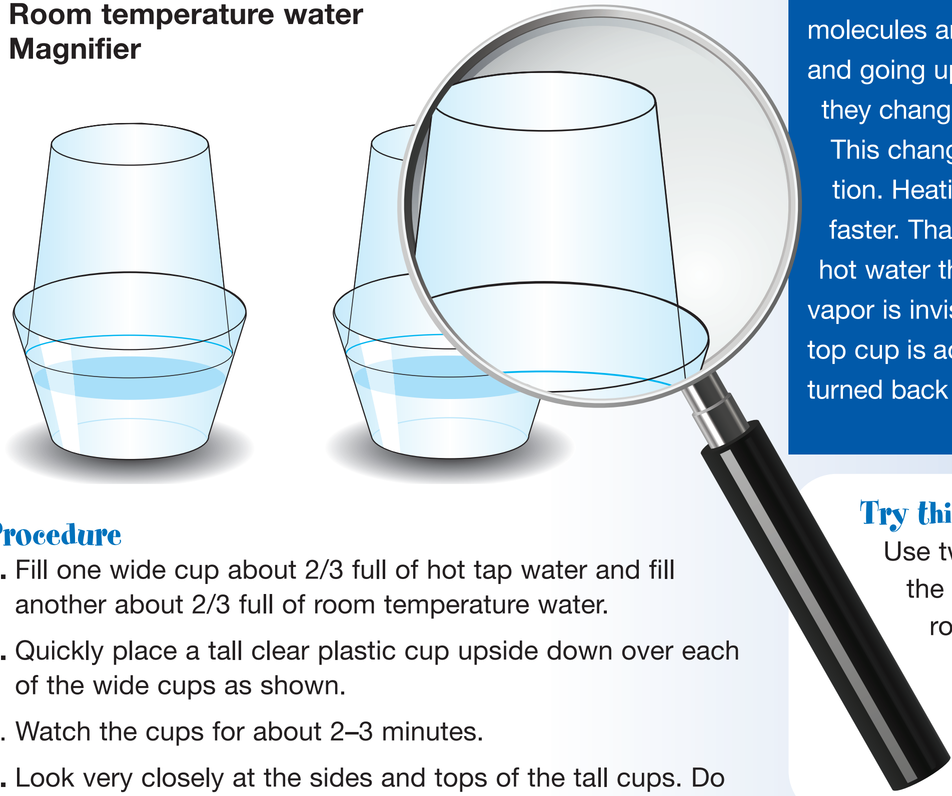
Go to **www.acs.org/earthday** for the solution.

Warm it UP!

Have you ever noticed that puddles seem to dry up faster on a warm day than on a cool day? What makes that happen, and where do you think the water goes?

Materials

- **2 wide clear plastic cups (punch cup)**
- **2 tall clear plastic cups**
- **Hot tap water**
- **Room temperature water**
- **Magnifier**



Procedure

1. Fill one wide cup about 2/3 full of hot tap water and fill another about 2/3 full of room temperature water.
2. Quickly place a tall clear plastic cup upside down over each of the wide cups as shown.
3. Watch the cups for about 2–3 minutes.
4. Look very closely at the sides and tops of the tall cups. Do you notice any difference between them? Use a magnifying glass if you have one. What do you think is on the inside of the cup over the hot water? How do you think it got there?

Think about this...

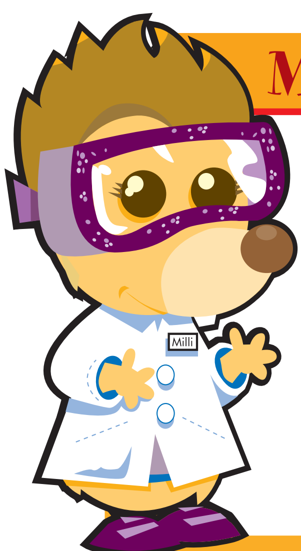
There are lots of examples where water evaporates faster when it is warm than when it is cold or room temperature. Wet towels and clothes dry faster in warm weather because the water evaporates faster. Can you think of any other examples?

Where's the Chemistry?

Any sample of water is made up of an enormous number of water molecules. At all times, some of the water molecules are breaking away from the rest of the water and going up into the air. When water molecules do this, they change from liquid water to water vapor—a gas. This changing from a liquid to a gas is called evaporation. Heating a liquid causes evaporation to happen faster. That's why there is more evaporation from the hot water than the room temperature water. The water vapor is invisible so what you see on the inside of the top cup is actually the water vapor that has already turned back to liquid water. This is called condensation.

Try this...

Use two more cups and add three ice cubes to the hot tap water, and three ice cubes to the room-temperature water. What do you see on the sides and top of the cups? What are the differences from the cups you have already studied?



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.
- Wear eye protection, specifically goggles.
- Follow safety warnings or precautions, such as wearing gloves or tying back long hair.
- Use all materials carefully, following the directions given.
- 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!

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ACKNOWLEDGMENTS
The *"Pop Rockets"* and the *"Warm It Up"* activities described in this publication were originally modified from *WonderNet,* a publication of the ACS Education Division. *"Pour CO_2"* was adapted from *"Chemistry with Charisma, 25 Lessons that Capture and Keep Attention in the Classroom, Terrific Science Press".* Meg A. Mole's interview was written by Kara Allen. *"What is Green Chemistry?"* was submitted by the ACS Green Chemistry Institute. 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.

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The Earth Day Edition of Celebrating Chemistry

is published annually and is available through your local Chemists Celebrate Earth Day Coordinator and the American Chemical Society (ACS). Chemists Celebrate Earth Day is a combined effort among the Office of Community Activities, the Committee on Community Activities, and several ACS Technical Divisions. Please visit www.acs.org/earthday to learn more.

Words to Know

Biodegradable
Materials that can be broken down, especially into harmless products, by the action of living things (such as microorganisms).

Volatile Organic Compounds-
Chemicals that evaporate easily at room temperature.

Sustainability
To meet the needs of the present without compromising the ability of future generations to meet their own needs.

Oxidation Reaction
Any chemical reaction that is the combination of a metal with a gas. The oxidation is a transfer of electrons from the metal to the gas.

Conservation
To preserve natural resources.

Greenhouse Gases
Gases reflect radiation from the earth and stop it from being lost into space. This causes the earth's temperature to be warmer than it would be without greenhouse gases.

Renewable Energy
Energy that is generated from natural resources—such as sunlight, wind, rain, tides, and geothermal heat—which are renewable (naturally replenished).

Hazardous Waste
Waste that can pose a hazard to human health or to the environment when improperly treated, stored, or disposed of.

Carbon Dioxide
A chemical compound composed of two oxygen atoms bonded to a single carbon atom.

Ozone Depletion
The destruction of the top-most layer of ozone gases in the atmosphere.

Climate Change
A long-term significant change in the temperature or precipitation of a region or the earth as a whole.

Zero Emissions
An engine, motor, or other energy source that emits no waste products that pollutes the environment.

Wind Power
Power formed from the kinetic energy of the wind by using wind turbines.

Wind Turbines
A rotating machine that converts the kinetic energy in wind into mechanical energy.

Recycle
The process of re-using a given product beyond its intended use, or producing a new product from a recyclable material.

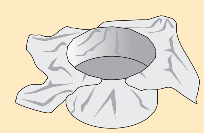
What is the American Chemical Society?

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 154,000 members. Most ACS members live in the United States, but others 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 22nd. 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! If you'd like more information about these programs, please contact us!

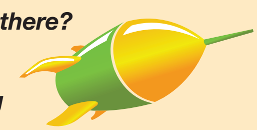
Knowledge Check-Up

Pouring CO_2



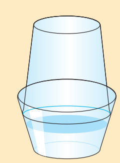
- ***Could you see the CO_2 in the cup as the candle light went out?***
- ***Why or why not?***
- ***How did you know that the CO_2 was there?***

Pop Rockets



- ***Could you feel a reaction happening when you shook the bottle?***
- ***Was the bottle hot or cold? Why?***

Warm It Up



- ***Did you see evaporation happening?***
- ***How do you know?***

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