

Celebrating Chemistry



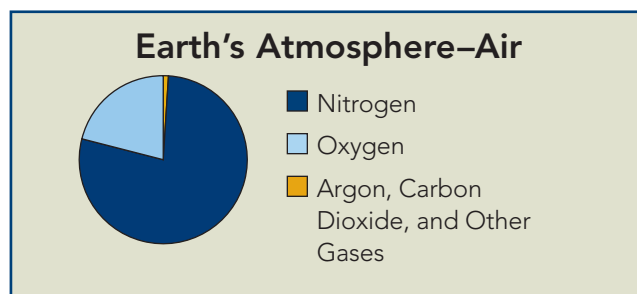
Earth's Atmosphere and Beyond!

National Chemistry Week • October 19–25, 2003 • American Chemical Society

The Earth is surrounded by a bubble of gas known as the atmosphere. Many of the other planets in our solar system are also enclosed in gas bubbles, but the mixture of gases on Earth is unique. This mixture is called air. We cannot see the air in our atmosphere and we cannot smell it—but the air is there. We can feel air as it blows across our skin, and we breathe it in and out of our noses and mouths. But what is air really, and is it the same everywhere?

Air is made mostly of nitrogen and oxygen, with small amounts of argon, carbon dioxide, and other gases. Although air contains very little of these other gases, they can make a big difference in how easily we breathe.

The quality of Earth's atmosphere is not the same everywhere. In big cities, the air has more exhaust fumes from cars than in small towns. But air blows around and mixes, so that on a windy day the exhaust fumes from cars may seem to go away. In reality, the exhaust fumes are still there but are spread out over a greater space, and we don't notice them as much. In the past few years, chemists and other scientists have been working on new fuels to reduce the amount of pollution in our



atmosphere, so that we can breathe easier on high-traffic days.

Many places on Earth have almost no air or very little of it. Although we cannot breathe at the bottom of the ocean, air is there. This air is mixed with the water, like gases in a can of soda. Fish can breathe the air in water because they have gills instead of lungs. Their gills let them pull the air out of the water, but our lungs do not. To go to the bottom of the ocean, we would need to take along a tank of air.

Very high mountaintops have more air than the ocean depths but not enough for humans to breathe comfortably. That is because Earth's atmosphere is quite thin,

with most of the air down near sea level. If we imagine the Earth as an orange, then we could say that the atmosphere is no thicker than the orange peel. As we climb up to a high mountaintop, the air gets thinner and there is less oxygen to breathe. Climbers on top of tall mountains like Mount Everest (8,850 meters above sea level) or K2 (8,611 meters above sea level) have very little energy and must wear oxygen masks for part of each day.

No air is on the moon or in outer space. Astronauts must stay inside their spacecraft or put on space suits with tanks of air to breathe when they are away from Earth. Astronauts on Mars or Venus would find an atmosphere made of various gases, but it would not be air. There is no special name for the gas mixtures on other planets. The name "air" is reserved for planet Earth. Therefore, we simply refer to the gases surrounding Mars as the Martian atmosphere and the gases surrounding Venus as the Venutian atmosphere.

As you read on in this newspaper, you will find out more about our atmosphere by doing hands-on activities. You will also learn about what it would be like to travel to some of the other planets in our solar system. Enjoy your exploration of Earth's atmosphere and beyond!

The First Airplane

At 10:35 a.m. on December 17, 1903, two brothers from Ohio flew the first successful airplane for 12 seconds and 120 feet along a beach in Kitty Hawk, North Carolina. Taking turns as pilot, they flew three more times that day. Each time they flew farther. On their fourth try, they managed to go 852 feet in 59 seconds—an amazing feat at the time. The two brothers had invented powered flight.

Orville and Wilbur Wright owned a bicycle shop in Dayton, Ohio. Although they had not gone to school to learn about airplanes or engineering, they were good mechanics. By repairing bicycles, they learned how gears and pulleys worked. They also learned to take careful notes about what they saw. Each time they made a new design and tested a machine, they took notes and made drawings. They would study these to figure out what they could do better the next time.

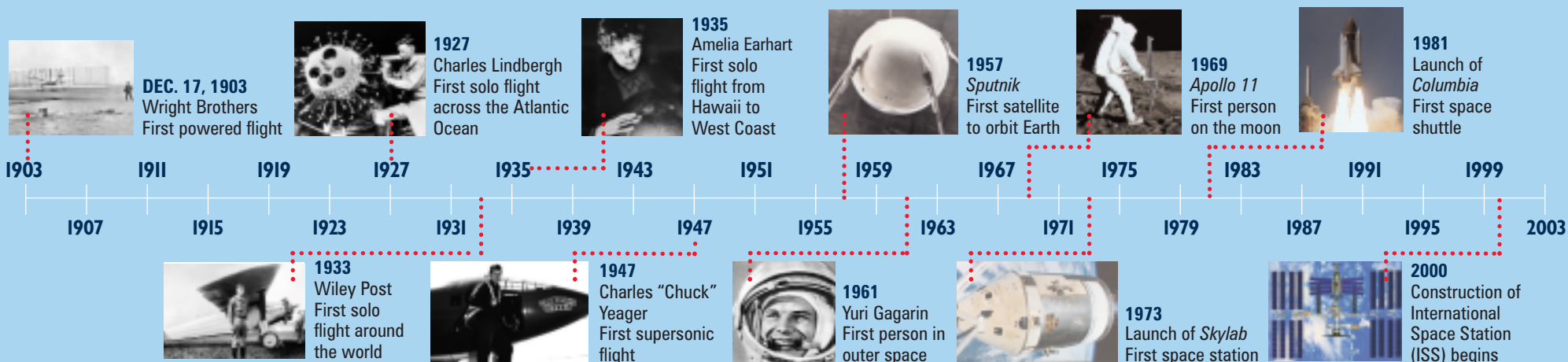
Before the Wright brothers flew, they did many things to prepare for this extraordinary achievement. They started years before by reading everything they could find about air, balloons, and kites. Then they made careful sketches of what they wanted to build. They began by making model kites to learn how air flowed over wings. These kites were small at first, like the ones that we might fly on a windy day. They made them bigger and bigger until they had a glider—a kite that is big enough to hold a person. Unlike a plane, a glider has no engine. The Wright brothers made three gliders before building their first airplane. Each time they made a glider, they would test it and make careful observations. Then they would use what they learned to make the next glider better.

When they made a glider that flew well, they added an engine. This step was harder than it sounds, because they had to find an engine that was both lightweight and

strong. The engines that they could buy were either too heavy or too weak, so they asked their friend Charlie Taylor to help. The first engine that Charlie built broke almost immediately, but the second one worked well.

After Orville and Wilbur installed the engine in their plane, they were almost ready. They simply had to wait for the perfect day with just the right amount of wind. On December 14, 1903, the wind was just right, and Wilbur climbed aboard. Orville helped guide the plane as it slid down a ramp made of wood. Suddenly, the plane went almost straight up, then stopped and crashed to the ground. Wilbur was not hurt, but the airplane was. The brothers fixed the plane and again waited for perfect conditions. On the morning of December 17, 1903, they had their chance. This time, with Orville as pilot, the airplane flew into history.

TIMELINE: 100 YEARS OF POWERED FLIGHT



Plane Smarts

The material used to build a plane is very important. If the material is too flimsy, the wings will fold and the plane will fall. If the material is too heavy, the wings will not be able to hold the weight of the plane. If the material is not flexible, the body of the plane will bend and crumple. Using the materials listed here, make a plane that will fly for long distances and land without too much damage.

Materials

- * Typing paper
- * Tissue paper
- * Card stock
- * Paper towel
- * Aluminum foil
- * Metric ruler
- * Blunt-end scissors
- * Masking tape
- * Marker
- * Meter (or yard) stick
- * Tape measure (optional)

NOTE: This activity should be done outside, in a gymnasium, or in a large empty hallway where there are no breakable objects. You will need a flight path that is about 5 meters (about 5½ yards) long.

SAFETY! Be sure to follow Milli's Safety Tips and do this activity only with adult supervision! Eye protection should be worn by everyone doing this activity.

Procedure

Make the Planes

- Use your ruler and scissors to trim the sheets of typing paper, tissue paper, card stock, paper towel, and aluminum foil so that they measure 216 x 280 mm (8½ x 11 inches). It is important that the different pieces of material be the same size.
- Fold each piece of material into a plane by following the diagram "Folding an Airplane" on the right. Be sure to make each one the same way.

Test the Planes

- Ask your adult partner to help you find an area outside, a large room like a gymnasium, or a hallway that you can use as a flight path for your planes. You will need a straight path that is about 5 meters (about 5½ yards) long.
- Mark one end of your flight path with a piece of masking tape. Using the marker, write "Start" on the tape. This is where you will stand to test your planes.
- Use your meter stick to measure 1 meter from the start. Mark this spot with masking tape and write "1 meter" on the tape.
- Repeat step 3 measuring 2, 3, 4, and 5 meters. Use the masking tape and marker to label each position. Alternatively, you can use a long measuring tape to mark the flight path.
- Put your toes on the piece of tape marked "Start", and throw the plane made out of typing paper as straight down the flight path as you can. Measure how far the plane went and record the results in the "What Did You Observe?" section. Did the plane crumple when it landed, or does it still look the same? Write your answer in the space provided in the "What Did You Observe?" section.

- Repeat step 5 with each of the other planes, and write down your answers in the "What Did You Observe?" section. Try to launch each plane the same way. For safety reasons, never fly a plane with a pointed tip.



Where's the Chemistry?

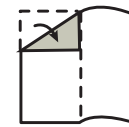
Each of the materials that you used to make your planes behaves differently. Some of the materials that you used to build your planes are very light. These materials would be good for planes that need to fly a long way on little fuel. However, they might not be rugged enough for rough weather or violent winds. Some of the materials that you used were very heavy but strong. Planes made of these materials would be strong but would need a lot of fuel to stay in flight. They probably could not go as high as the lighter planes. The plane that you made out of aluminum foil probably crumpled when it landed, so it might not be good for repeated flights without reinforcement. Commercial airliners are made from aluminum but have an inner skeleton to make them stronger. Can you think of any other materials that you could use to make an airplane?

Folding an Airplane

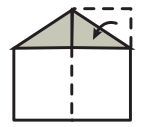
- Fold the sheet in half vertically, and then reopen it.
- Fold the top left corner of the page down until it meets the middle fold.
- Fold the top right corner of the page down until it meets the middle fold.



1

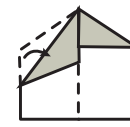


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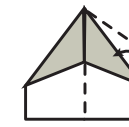


3

- Fold the left corner of the page down until it meets the middle fold to form a wing flap.
- Repeat with the right corner.
- Fold the tip down so that it meets the point made by the wing flaps.



4



5

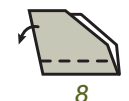


6

- Fold the plane in half along the center crease.
- Fold each side down to form two wings. You should make your fold approximately 1 cm from the bottom of the plane (see dashed line below).



7



8



What Did You Observe?

Plane (material used)	Distance traveled	Appearance after flight
Typing paper	_____ meters	
Tissue paper	_____ meters	
Card stock	_____ meters	
Paper towel	_____ meters	
Aluminum foil	_____ meters	

Which plane flew the farthest?

Which plane crumpled when it landed?

Which plane flew the straightest?

Bubble-o-meter

Gases are all around us. Air is a mixture of gases, and those gases take up space. In this activity, you will see what happens when you warm a gas and when you cool it!

Materials

- * Disposable paper or plastic cup (3 oz.)
- * Measuring spoon (1 teaspoon)
- * Liquid dishwashing detergent
- * Water
- * Plastic bottle (½ L, empty)
- * Warm water
- * 2 bowls
- * Ice



ADAPTATION

A magnifying glass may be used to see the soap film.



SAFETY!

Be sure to follow Milli's Safety Tips and do this activity only with adult supervision! Do not drink any of the liquids used in this activity. Eye protection must be worn by everyone performing this activity.

Procedure

1. In the cup, mix 1 teaspoon of liquid detergent with about 2 teaspoons of water to make a bubble solution.
2. Dip the open top of the bottle into the detergent solution. Carefully tilt and lift the bottle out so that a film of bubble solution covers the opening of the bottle. Draw a picture of your bottle in the "What Did You Observe?" section.
3. Gently hold your hands around the bottle, without squeezing. What happens to the film? Write your answer and draw a picture of what happens to the film in the "What Did You Observe?" section.

4. Ask your adult partner to place some warm tap water in a bowl. If the soap film has popped, re-dip the bottle into the detergent solution. Place the bottom of the bottle in the warm water. What happens? Write your answer and draw a picture of what happens to the film in the "What Did You Observe?" section.
5. Put some ice and water in another bowl. Now place the bottom of the bottle into the ice water. What happens? Write your answer and draw a picture of what happens to the film in the "What Did You Observe?" section.
6. Pour the water and the bubble solution down the drain. Throw the bottle and the cup in the trash. Thoroughly clean the work area, and wash your hands.



Where's the Chemistry?

Gases, like most solids or liquids, take up more space (expand) when they are heated. The opposite is also true. Most solids, liquids, and gases take up less space (contract) when they are cooled. The difference is that gases expand a lot more than liquids or solids when heated and contract a lot more when cooled.

What Did You Observe?

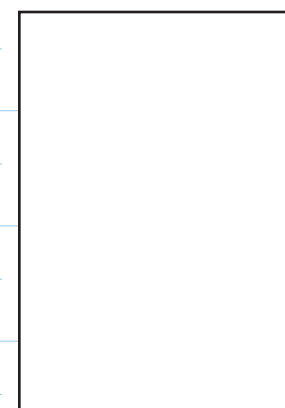
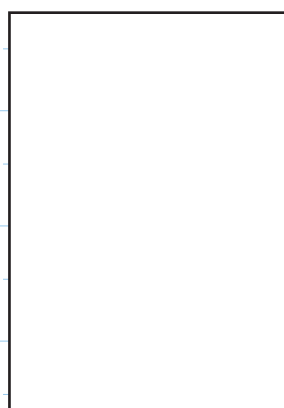
Draw a picture of your bottle for each description below.

Bottle with film

Bottle with hands around it

Bottle in warm water

Bottle in ice water



What happened to the film of bubble solution when you warmed the bottle with your hands?

What happened to the film of bubble solution when you put the bottle in warm water?

What happened to the film of bubble solution when you put the bottle in ice water?

Milli's Safety Tips!

Safety First!

Always:

- Perform the activities with adult supervision.
- Read and follow all directions for the activity.
- Read all warning labels on all materials being used.
- Wear eye protection, specifically splash and impact-resistant goggles.
- Follow safety warnings or precautions, such as wearing aprons and 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 used away from your mouth, nose, and eyes!
- Never experiment on your own!

For more information on safety go to chemistry.org/ncw and click on "Safety Guidelines".



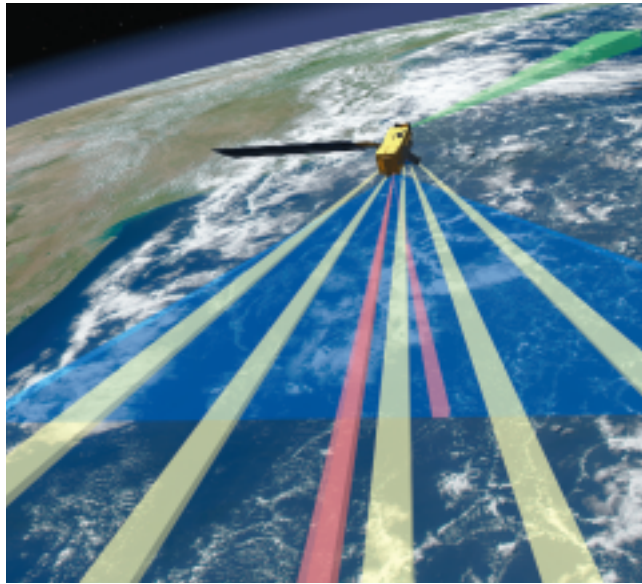
Ozone: Friend AND Foe

Does your city or town have “bad air” days in the summertime? Are you reminded to wear sunscreen when you go out to play? The same gas—ozone—that is the main factor in “bad” air also protects us from the sun’s harmful effects. How can one gas be both good and bad?

Ozone is a gas that occurs naturally in very, very small amounts in the Earth’s atmosphere. But human beings make more ozone every day. Ground-level ozone is formed when exhaust from cars, trucks, factories, and lawn mowers interact with sunlight—especially in the late spring and summer. When ozone is close to the ground, it can irritate lungs and trigger asthma attacks. Some communities offer free bus rides, encourage carpooling, and ask people to mow lawns or fill gas tanks in the evening on high ozone days.

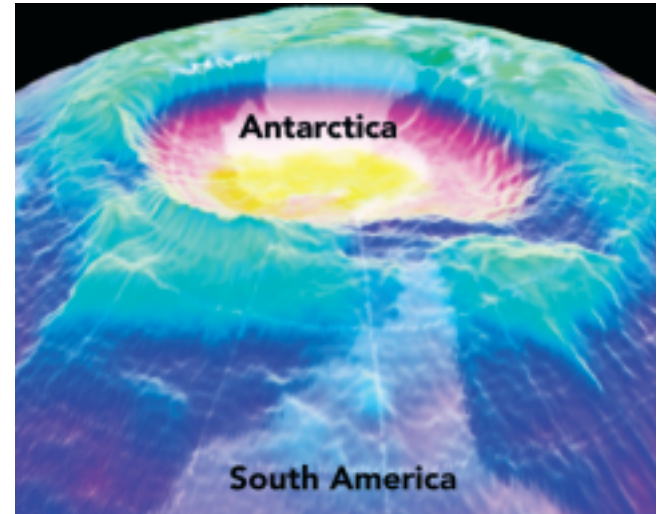
But we wouldn’t want to get rid of ozone entirely. Ozone is our protection from the sun’s ultraviolet (UV) light, which can cause sunburn, skin cancer, and eye damage. High in the atmosphere, about 25 kilometers above the Earth, ozone serves as a protective layer that absorbs harmful UV light.

Certain materials, such as those used in air conditioners, refrigerators, and spray cans, can damage the ozone layer. When damage occurs, more UV light leaks through. Each fall, the results are visible over Antarctica, where an “ozone hole” forms. Because this “hole” has so little ozone, it allows lots of UV light to leak through. The red and yellow areas in the image [far right] show the location and size of the “ozone hole” over the South Pole during October 2001.



Drawing of the AURA satellite as it will appear in orbit 700 km (435 miles) above Earth. Image courtesy of NASA.

NASA will soon launch a new satellite into orbit around Earth to measure ozone. Called AURA, the satellite will measure many other gases, as well as smoke and dust in both the lower and upper atmospheres. It will also be able to measure and track chemicals that produce ozone. Look for the launch of this new NASA satellite in January 2004!



View of the South Pole from the TOMS (Total Ozone Mapping Spectrometer) satellite 740 km (460 miles) above Earth. South America and Antarctica are labeled. Blue and green areas have relatively large amounts of ozone, and the yellow and red areas have very little.

World leaders have agreed to work together to reduce the amount of ozone-depleting substances released into the atmosphere. You can reduce the amount of ground-level ozone by walking, riding a bike, taking public transportation, or carpooling. By lowering the number of automobiles on the road, we can reduce the amount of pollution in our air.

Is Air Really There?

If you go to your closet and take all your stuff out, is it really empty?

If you uncup a bottle of soda and pour its contents in a glass, is the bottle really empty?

If you open a can of food and pour it into a bowl, is the can really empty?

The answer to all of these questions is “no”—because air is still inside the containers. As soon as you take the stuff out of your closet, pour your soda in a glass, or pour the food out of the can, air flows inside to fill the “empty” space.

If you don’t believe it, ask an adult to help you try this...

1. Empty a small bottle of water or soda.
2. Turn the bottle upside down, so that the opening points down, and push it into a large bucket or sink filled with water.
3. Slowly flip the bottle right side up again while keeping it underwater.

What happened? Did you see bubbles? What was in the bubbles? Did the bottle stay empty?

When you turned the bottle right side up again, the air that was trapped inside the bottle escaped as bubbles. The water that was inside the bucket or sink flowed into the bottle until it was full. So the bottle was never really “empty”.

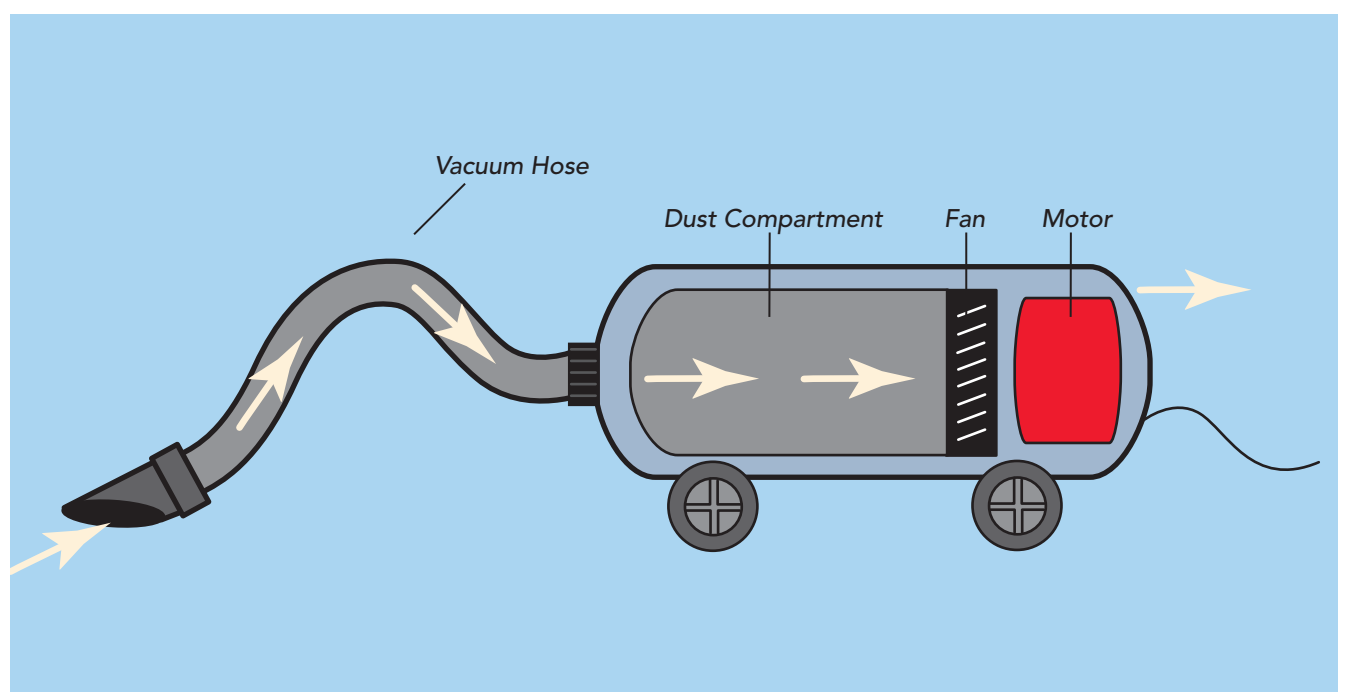
A space that is truly empty is called a vacuum. On Earth, we don’t have any truly empty spaces, because air—or something else—is everywhere. But we can remove some of the air from a place temporarily. One way to do this is with a vacuum cleaner.

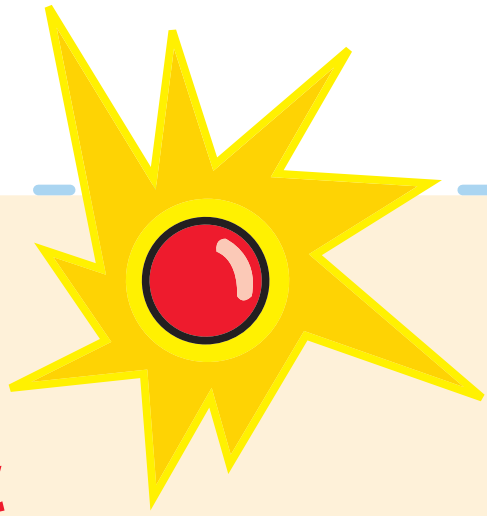
A compartment in the middle of a vacuum cleaner catches dust and dirt in a bag. A small hole for attaching

a hose is at one end of the compartment, and a fan is at the other. Most vacuum cleaners also have other parts, like beater brushes and nozzles, but inside they are all about the same. They have a dust compartment (which may have a bag in it), a hose (with a nozzle on the end), and a fan. See the illustration below.

When you turn on a vacuum cleaner, the fan inside starts to spin very quickly. The fan is positioned so that it

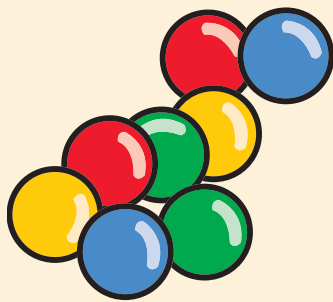
pulls air out of the dust compartment and blows it out the back of the vacuum cleaner. As a result, air must rush through the hose at the other end to refill the dust canister. Because the fan blows the air out of the vacuum cleaner faster than the air can race through the hose to refill it, a “partial vacuum” occurs. The result is that the vacuum cleaner sucks air and dust through the hose, helping us clean our floors and carpets.





Colorful Candy Clouds

Wind can carry smoke, dust, and gases hundreds of miles in only a few days. Satellite pictures of dust storms in the Sahara Desert show that some of the dust actually travels across the Atlantic Ocean and falls onto the southeastern United States. Because we can't see air, we can't really tell where it is going unless we feel it on our skin or see a cloud drift by. In this activity, you will drop colored candies into warm water to imitate the way that smoke, dust, and gases move in air.



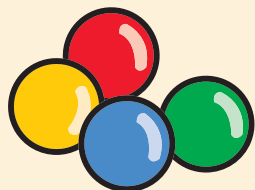
Materials

- * Disposable square plastic dish (sandwich-size)
- * Warm tap water (not hot water)
- * Candies with a hard, colored shell

SAFETY! Be sure to follow Milli's Safety Tips and do this activity only with adult supervision! Do not eat the candy or drink the water used in this activity. Eye protection must be worn by everyone doing this activity.

Procedure

1. Ask your adult partner to help you partially fill the plastic container with warm water. The water in the container should be about 2 cm (a little less than 1 inch) deep.
2. Select three pieces each of four different colors of candy. For example, you could have three red, three yellow, three blue, and three green pieces for a total of 12 pieces of candy.
3. Separate the candies by color. Put the candies into the water-filled container so that each corner has a different color. Be careful not to stir the water.
4. Watch carefully as the candies begin to dissolve. Write what you saw in the "What Did You Observe?" section.
5. Pour the water down the drain, and throw the candy and plastic dish in the trash. Thoroughly clean the work area, and wash your hands.



Where's the Chemistry?

Air is constantly moving from one place to the other. Sometimes we can tell that it is moving, and sometimes we cannot. One of the ways that early scientists tracked how fast winds were blowing was by watching clouds. In this activity, you made clouds of color in the water. The clouds moved, even though you did not mix the water. Clouds in the sky

do the same thing. Today, satellites give us a view from above that tells which way the wind is blowing. We can also use Doppler radar to find out wind speed and direction. By combining these two techniques, weather forecasters are able to warn us of storms, so that we can take cover before trouble hits.



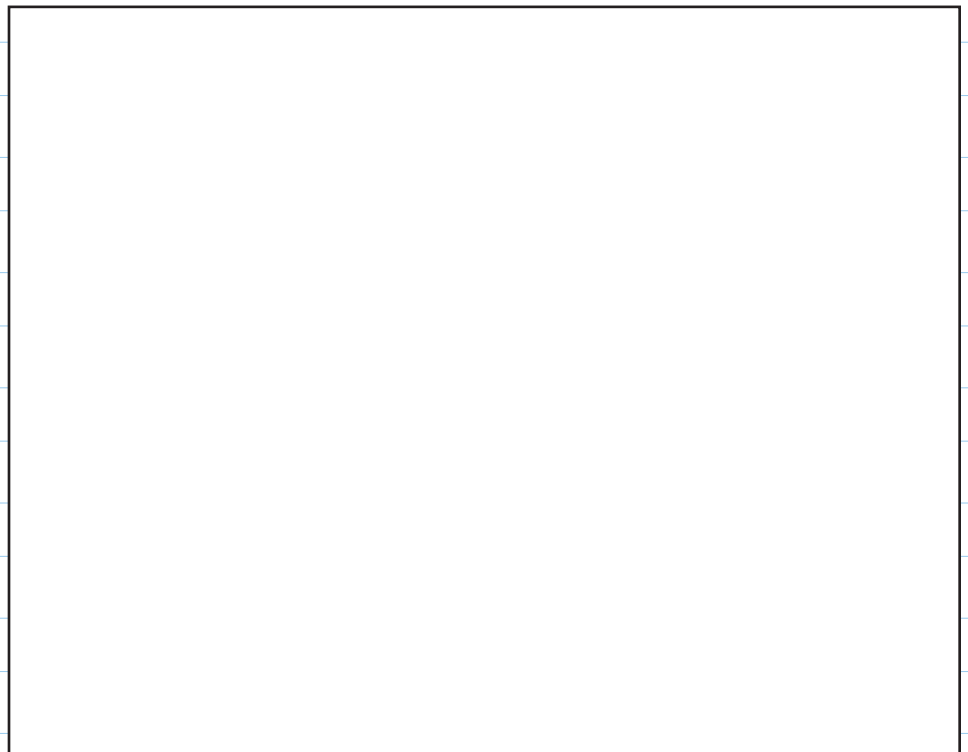
What Did You Observe?

What four colors of candy did you choose?

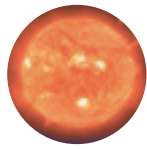
_____, _____, _____, and _____

What happened to the candy colors when you added the candies to the water?

Draw a picture of what you observed.



Out of This World Trivia



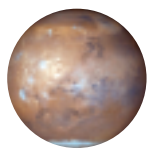
Sun

- Diameter: 1,400,000 km (870,000 miles)
- Makes one full rotation every 25 Earth days
- Average temperature at the center: 15 million°C (27 million°F)
- Average surface temperature: 5527°C (9980°F)
- Outer layer is composed mostly of hydrogen, with some helium and smaller amounts of other gases



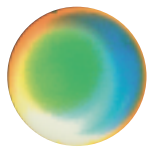
Mercury

- Average distance from the sun: 57,910,000 km (35,984,000 miles)
- Diameter: 4,878 km (3,031 miles)
- Orbits the sun every 88 days
- Makes one full rotation every 59 days
- Surface temperature: -183°C to 427°C (-297°F to 801°F)
- Atmosphere: no significant atmosphere



Mars

- Average distance from the sun: 227,940,000 km (141,635,000 miles)
- Diameter: 6,794 km (4,222 miles)
- Orbits the sun every 687 days
- Makes one full rotation every 24 hours
- Average surface temperature: -23°C (-9°F)
- Atmosphere: carbon dioxide and some nitrogen and argon



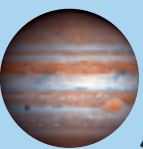
Uranus

- Average distance from the sun: 2,870,990,000 km (1,783,950,000 miles)
- Diameter: 51,118 km (31,763 miles)
- Orbits the sun every 84 years
- Makes one full rotation every 17 hours
- Surface temperature: -214°C (-353°F)
- Atmosphere: mostly hydrogen and helium with traces of methane



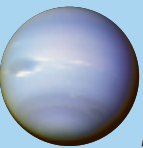
Venus

- Average distance from the sun: 108,200,000 km (67,232,000 miles)
- Diameter: 12,104 km (7,521 miles)
- Orbits the sun every 224 days
- Makes one full rotation every 243 days
- Surface temperature: 475°C (887°F)
- Atmosphere: carbon dioxide, rains sulfuric acid



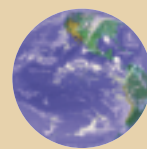
Jupiter

- Average distance from the sun: 778,330,000 km (483,632,000 miles)
- Diameter: 142,984 km (88,846 miles)
- Orbits the sun every 12 years
- Makes one full rotation every 10 hours
- Surface temperature: -149°C (-236°F)
- Atmosphere: mostly hydrogen and helium



Neptune

- Average distance from the sun: 4,504,300,000 km (2,798,840,000 miles)
- Diameter: 49,528 km (30,775 miles)
- Orbits the sun every 165 years
- Makes one full rotation every 19 hours
- Surface temperature: -214°C (-353°F)
- Atmosphere: methane, hydrogen, and helium



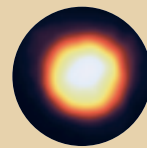
Earth

- Average distance from the sun: 149,600,000 km (92,957,000 miles)
- Diameter: 12,756 km (7,926 miles)
- Orbits the sun every 365 days
- Makes one full rotation every 24 hours
- Average surface temperature: 15°C (59°F)
- Atmosphere: nitrogen and oxygen with smaller amounts of other gases



Saturn

- Average distance from the sun: 1,429,400,000 km (888,188,000 miles)
- Diameter: 120,536 km (74,898 miles)
- Orbits the sun every 29 years
- Makes one full rotation every 10 hours
- Surface (atmospheric) temperature: -180°C (-292°F)
- Atmosphere: mostly hydrogen and helium



Pluto

- Average distance from the sun: 5,913,520,000 km (3,674,490,000 miles)
- Diameter: 2,320 km (1,442 miles)
- Orbits the sun every 248 years
- Makes one full rotation every 6 days, 9 hours, 17 minutes
- Surface temperature: -233°C (-388°F)
- Atmosphere: nitrogen with traces of methane and carbon monoxide

Planets come in all sizes. Some are very small like Pluto (see the yellow dot on page 7), and some are very large like Jupiter (see the light blue circle behind this text). The circles in the background show how the sizes of the planets in our solar system compare with one another.

The atmospheres and temperatures of the planets also vary. Of the planets listed below, which one is most like Earth? Which one is the most different?

Jupiter

Saturn

Uranus

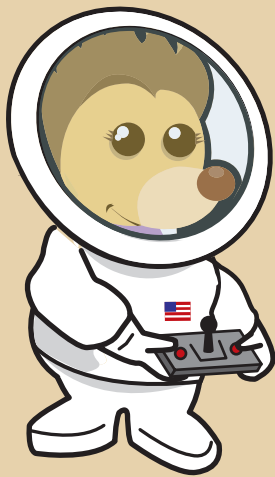
Mars Flyer

Chemists at NASA are always planning ahead. One of the many ideas that they are considering is a remote-controlled plane called ARES that would fly on Mars. Among other experiments, the plane would test the planet's atmosphere and radio the results back to Earth. If you designed a plane to fly on Mars, what would it look like, and what would you test?

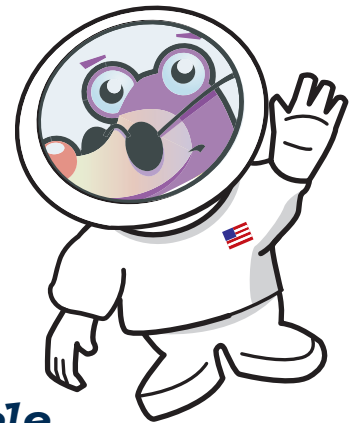
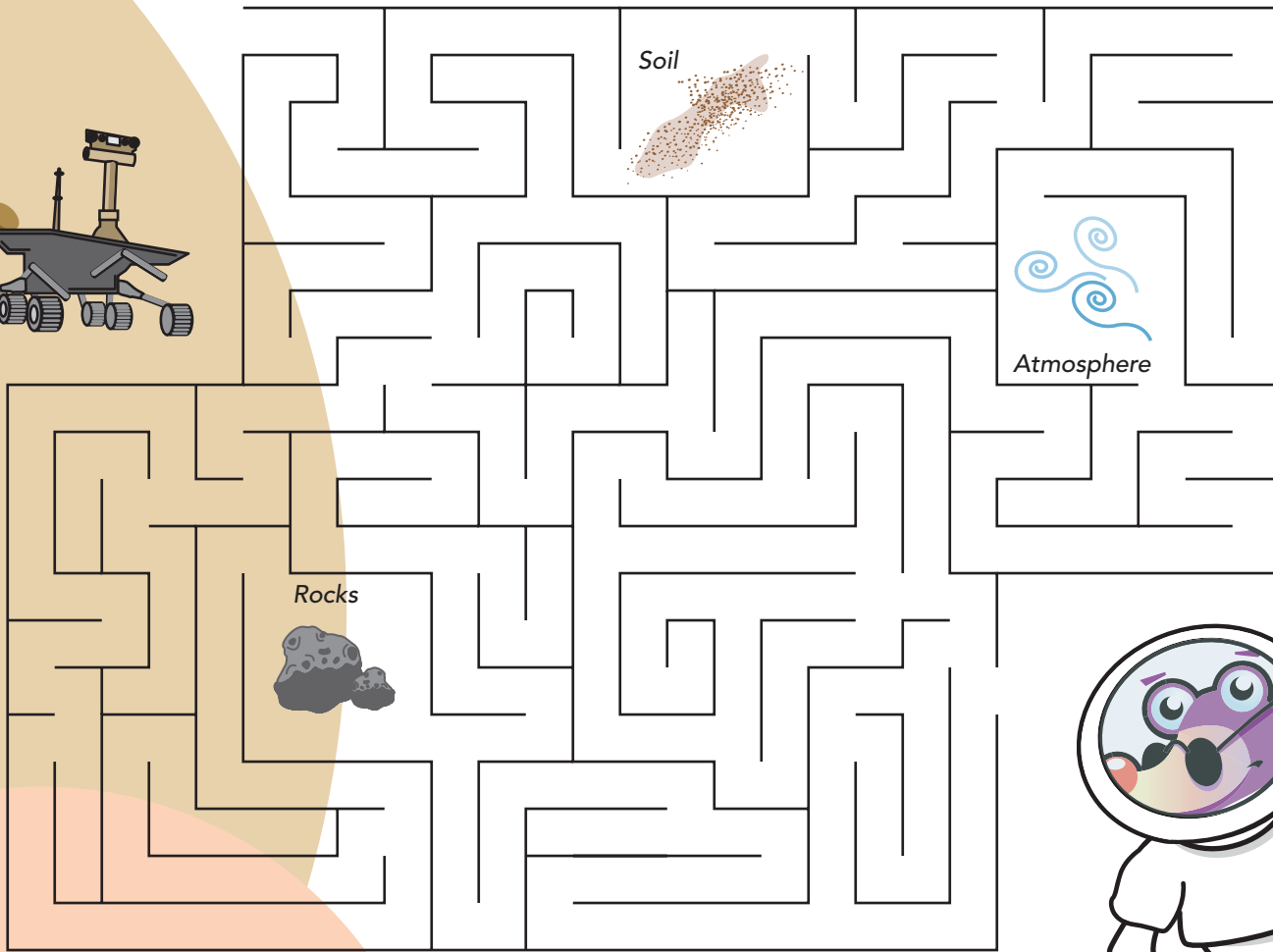
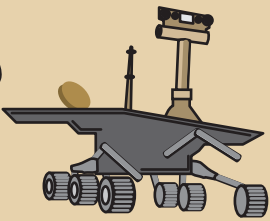


Martian Maze

Help Milli guide the Mars Rover through the maze to Avogadro by drawing a path. Be sure to collect samples of the atmosphere, soil, and rocks along your way.



Milli Mole



Avogadro the Mole

Neptune

Earth

Venus

Mars

Mercury

Pluto



What is Acid Rain?

We all know what rain is. It is water that falls from the sky. But what is acid rain? Acid rain comes from air pollution. It looks just like regular rain. Although it has very little effect on us, it makes a big difference for plants and also eats away slowly at stone, metal, and buildings.

Acid rain is not new. It was first noticed in England about 200 years ago. Most of the cities in England are quite old and have many buildings with marble carvings and statues. Marble is a beautiful stone that stands up well over time. Many of the statues carved by the ancient Greeks and Romans still stand. But marble dissolves in acid rain (see “Disappearing Statues”, to the right). During the late 1800s, people began to notice that marble statues and carvings were slowly starting to dissolve. Fine details were gone, and larger features on the statues, such as noses and ears, were disappearing. Scientists turned to chemistry for the answer. By testing rainwater, they were able to figure out that it contained an acid and that the acid was reacting with the statues.

At that time, most people used coal to cook their food and stay warm through the winter. The coal that they used had a lot of sulfur in it that burned to form sulfur dioxide. The sulfur dioxide floated up into the air with the smoke from the fire and mixed with water vapor in the clouds. When sulfur dioxide and water mix in air, they react to make sulfuric acid. The sulfuric acid stays mixed in the water vapor and falls to the ground as “acid rain”. Acid rain can also come from other sources, such as exhaust fumes from cars and other gas-powered engines.

Acid rain also affects plants and animals. Along the east coast of the United States, where acid rain is a problem, some trees have begun to lose their leaves or needles. New trees have also been slow to grow, and few seeds are able to sprout. Ponds and streams have also been contaminated, which causes problems for fish.

In the United States, most of the pollution that causes acid rain comes from electric power plants that burn coal to make energy. Recently, chemists working for the power plants have begun to install “scrubbers” on the coal furnaces. The scrubbers wash the exhaust fumes with water to remove the sulfur dioxide. Some other pollutants remain, but the amount of pollution produced has been greatly reduced.

Acid rain-producing pollution from cars has also been reduced in recent years. All new cars sold in the United States must have a “catalytic converter” installed. It is a device that gets rid of the pollutants that make acid rain. Chemists at gasoline companies have also been working hard to invent detergents and other additives that keep car motors clean on the inside. Cleaner engines work better, use less fuel, and produce less pollution.

We can help to prevent acid rain in many different ways. For example, we can switch from gas-powered lawn mowers and leaf blowers to tools powered by electricity. Last year, lawn mowers produced about one-tenth of the air pollution in the United States. We can also cut down on air pollution by walking, carpooling, or taking public transportation. Finally, we can look for cleaner-burning fuels. Chemists and engineers are developing new technologies, such as hydrogen-fueled cars, gas/electric hybrids, and more efficient electric motors.

If we all do our part, we can make the planet a better place to live, and we can ensure that future generations will have clean air, water, and soil.

Disappearing Statues

Acids are substances that have a sour taste and strong smell. Lemon juice and vinegar are common acids. Acid rain is formed when pollution in the air mixes with the rain and falls to the ground. In this activity, vinegar will represent acid rain, and an antacid tablet will represent a marble statue in a city park. Both the antacid tablet and marble are made of the same chemical: calcium carbonate.

Materials

- * Pencil
- * 2 antacid tablets (*Look at the ingredients label on the back of the bottle. The active ingredient should be calcium carbonate.*)
- * Small disposable paper plate
- * 2 disposable paper or plastic cups (3 oz.)
- * Masking tape
- * Marking pen
- * 2 droppers or pipettes
- * Measuring spoon (tablespoon)
- * Water
- * Vinegar

NOTE: *It is best to use antacid tablets without any acids among the ingredients. Look on the back of the bottle to see if the word “acid” appears in the list of inert ingredients. Less expensive generic or store brands usually work best for this activity.*

ADAPTATION *To prevent spills, a cupcake pan may be used in place of cups. A magnifying glass may be helpful to see the reactions. In addition, a rubber stamp and inkpad may be used to make a design on the antacid tablets—but be sure to use waterproof ink.*

SAFETY! *Be sure to follow Milli’s Safety Tips and do this activity only with adult supervision! Do not drink any of the liquid samples in this activity. Keep your face away from the cups. Eye protection must be worn by everyone doing this activity.*

Procedure

1. Using the pencil, draw a face or picture on the smooth side of each antacid tablet.
2. Place the two antacid tablets on a paper plate with your drawings facing up. One of the tablets should be on the right side of the paper plate, and the other should be on the left.
3. Using the masking tape and marking pen, label one cup “water” and the other “vinegar”.
4. Ask your adult partner to help you pour 1 tablespoon of water into the cup labeled “water” and 1 tablespoon of vinegar into the cup labeled “vinegar”.
5. Use the marking pen to label one of the droppers with a “W” for water and the other dropper with a “V” for vinegar.
6. Using the dropper labeled “W”, carefully place three drops of water onto one of the antacid tablets. Watch what happens to the tablet, and write your observations in the “What Did You Observe?” section.
7. Using the dropper labeled “V”, carefully place three drops of vinegar onto one of the antacid tablets. Watch what happens to the tablet, and write your observations in the “What Did You Observe?” section.

8. Thoroughly clean the work area. Pour the liquids down the drain, and rinse the containers. Throw away any other trash, including undissolved tablets. Be sure to wash your hands.

What Did You Observe?

What happened to the antacid tablet when you dropped water onto it? Is the picture that you drew on the tablet still there, or did it disappear?

Draw a picture of the antacid tablet with water on top.

What happened to the antacid tablet when you dropped vinegar onto it? Is the picture that you drew on the tablet still there, or did it disappear?

Draw a picture of the antacid tablet with vinegar on top.



Where's the Chemistry?

The tablet treated with vinegar is eaten away in much the same way that acid rain eats away at a marble statue, only faster. The vinegar is reacting chemically with the calcium carbonate in the antacid tablet. The calcium carbonate is used up, and a gas called carbon dioxide is formed. Acid rain is more acidic than normal rain and is caused by pollution in the air.



Volcano

Volcanoes are openings in the surface of the earth through which molten rock (called magma), dust, and gas can escape. Volcanoes played an important role in the formation of the Earth, and they continue to erupt on land and beneath the sea. In this activity, you will make a pretend volcano and watch what happens when it "erupts."

Materials

- * Empty 35-mm film canister
- * Large plastic plate or container
- * Clay or sculpture dough (approximately ½ lb.)
- * Measuring spoons
- * Small disposable plastic cup (3 oz.)
- * Vinegar
- * Liquid dish detergent
- * Few drops of red food coloring (optional)
- * Baking soda

NOTE: This activity is quite messy. It is important that it be conducted near a sink or with a bucket and water close by. Consider doing the activity on a tray to catch the lava overflow.

SAFETY! Be sure to follow Milli's Safety Tips and do this activity only with adult supervision! Do not drink any of the liquid samples in this activity. Eye protection must be worn by everyone doing this activity.

Procedure

1. Place the film canister in the center of the plastic plate.
2. Shape the clay or dough around the canister to form a mountain. Do not cover the opening of the film canister or get dough inside it.
3. Place 1 tablespoon vinegar in the small plastic cup. Add ½ teaspoon liquid dish detergent and food coloring if desired. Swirl gently to mix.

4. Measure ½ teaspoon baking soda into the film canister.
5. Carefully pour the vinegar solution into the film canister, and watch what happens.
6. Draw a picture of your volcano in the "What Did You Observe?" section.
7. Thoroughly clean the work area and wash your hands. Pour liquids down the drain. Rinse and throw away any other trash. If you wish to keep your "volcano," you may rinse it off with water and let it air dry.



Where's the Chemistry?

The combination of the baking soda (sodium bicarbonate) and the vinegar (acetic acid) reacts to produce carbon dioxide gas. As the reaction occurs, the carbon dioxide gas bubbles up through the mixture and helps to create the foam that goes out and down the sides of your volcano. Carbon dioxide is just one of the gases that volcanoes release into the atmosphere. Water vapor and sulfur dioxide are among the other gases they release. The gases from volcanoes hundreds of millions of years ago helped make the Earth's atmosphere, and today's volcanoes continue to contribute gases. The eruption of Mount St. Helens in 1980 was the last major eruption in the lower 48 United States, but Kilauea in Hawaii has erupted continuously since January 3, 1983. Several active volcanoes are in the Aleutian Island chain in Alaska.



What Did You Observe?

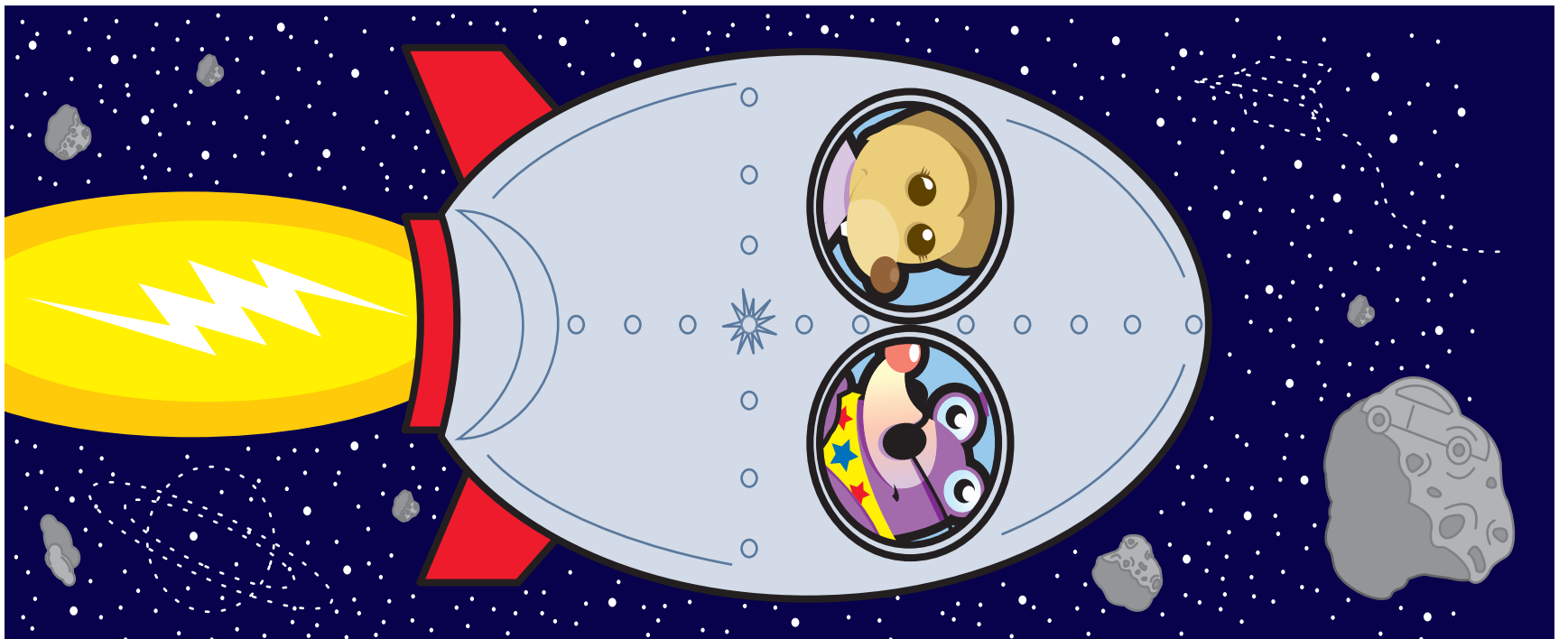
Draw a picture of your volcano as it was erupting.

Hidden Objects

Check off each object as you find it!

- Crescent moon
- Cloud
- Paper Airplane
- Car
- Raindrop
- Planet
- Sun
- Lightning bolt

Answers on page 12.





Night Spectra Quest

In the daytime, light comes from many different places, so it is very hard to tell the exact source of the light that you are seeing. But at night, there are not very many lights, so you can look at each one individually. In this activity, you will look at different light sources through a diffraction grating. The diffraction grating separates light into many different colors. This pattern of colored light is called a "spectrum."

Materials

✦ Diffraction grating, or Night Spectra Quest card

(Night Spectra Quest cards are available through the ACS online store at chemistry.org/store in the National Chemistry Week section.)



ADAPTATION Sound, like light, comes from a mixture of sources. If we listen closely, we can learn the unique sounds that different musical instruments make. Once we know how they sound we can identify them even when more than one type of instrument is playing. Learn the sounds that a violin, an oboe, and a banjo make, and then listen to different songs. Can you tell when a specific instrument is playing?



SAFETY! Be sure to follow Milli's Safety Tips and do this activity only with adult supervision! Do not look directly at any bright light source. **DO NOT LOOK AT THE SUN! PERMANENT EYE DAMAGE COULD RESULT.**

Procedure

1. Ask your adult partner to take you for a walk at night after the sun has set.
2. Look through the diffraction grating at different sources of light, such as car headlights, streetlights, and neon signs. Can you see a difference in the pattern of colors that each one makes? Describe what you saw in the "What Did You Observe?" section.



Where's the Chemistry?

Scientists use the light from stars and planets to figure out what they are made of. This is possible because every element has a different "fingerprint of light" called a "spectrum". The light from a star may be the result of combinations of several different elements, such as hydrogen or helium. But because each element has a different spectrum, we can tell which elements are present from millions of miles away.



The Adventures of Meg A. Mole, Future Chemist

I have spent the past few months visiting several chemists to find out what they do at work, because

I knew so little about them. I found out that they do a lot of different things. Some chemists make plastics for bottles and toys. Others make medicines so that people can feel better. Still others make sure that the air that we breathe, the water that we drink, and the food that we eat is safe for us.

One of the chemists that I met was **Professor F. Sherwood Rowland**. Professor Rowland teaches at the University of California in Irvine, California. He also does research on air. Professor Rowland and his students have collected air samples from all around the world. They have been able to figure out that air is not the same everywhere. In some places it has more pollution than in others. The amount of pollution in and around cities is much higher than in areas far away from lots of people.

Professor Rowland wasn't always a scientist, but he always worked hard in school. He started first grade when he was five, and he skipped the fourth grade completely. In fact, he started high school when he was just 12 years old, and graduated just before his 16th birthday. He also started college early and became involved with the basketball and baseball teams. He was quite good at both sports, and even played baseball semi-professionally for a Canadian team in the summer. While in college, Professor Rowland studied chemistry, physics, and math. Later in graduate school he got his Ph.D. in chemistry.

Professor Rowland has had a very successful career studying chemistry in the atmosphere, and, in 1995, he was awarded the Nobel Prize in Chemistry along with Professors Paul J. Crutzen and Mario J. Molina. Together they discovered the cause of the ozone hole (see "Ozone: Friend AND Foe", page 4).

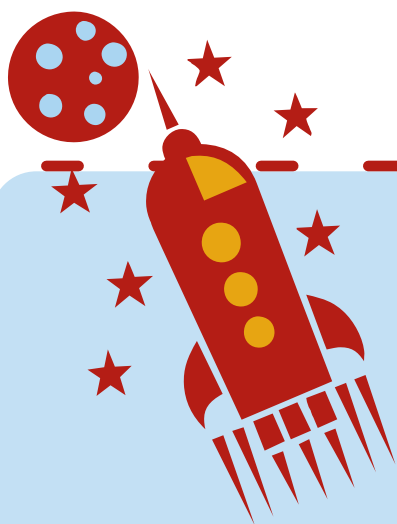
Chemists do many different things that make our lives better.



F. Sherwood Rowland playing baseball during his college years.

What Did You Observe?

Light source	Description of spectrum
1.	
2.	
3.	
4.	



Pop Rockets

One important characteristic of 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

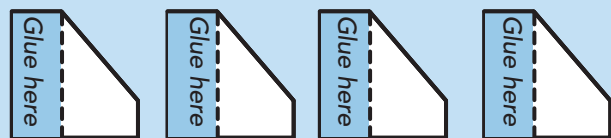
NOTE: This activity can be messy and should be conducted outside.

SAFETY! Be sure to follow Milli's Safety Tips and do this activity only with adult supervision! Do not eat or drink the water used in this activity! Eye protection must be worn by everyone present in the launch area!

Procedure

Build the Rocket

1. To make fins for the rocket, trace the patterns below onto a file folder, or a piece of card stock.
2. Cut along the solid lines so that you make four fins.

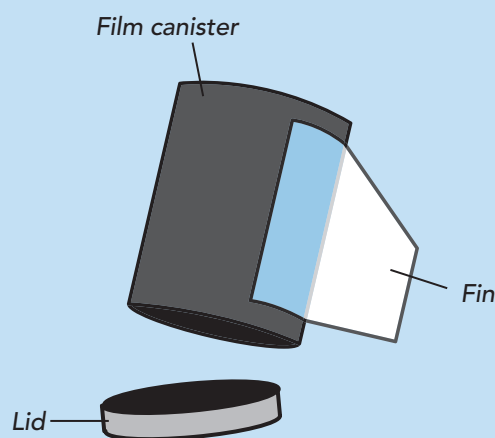


3. Fold the fins along the dotted lines.
4. Place glue on each of the fins in the area marked "Glue here" in the picture above, and attach each of the fins to the film canister. Be sure to have the point of the triangle towards the closed end of the canister and to leave enough room to put the lid on the open end of the canister.
5. Fold the fins so they stick straight out from the canister.

Fuel the Rocket

1. Ask your adult partner to help you select an appropriate area outside 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.

4. Close the canister, quickly place it on the launch area with the lid at the bottom, and take at least three 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 unreacted 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 and your rocket is launched.



What Did You Observe?

How many seconds did it take for the rocket to launch after it was sealed?



seconds

About how high did the rocket go into the air?



meters



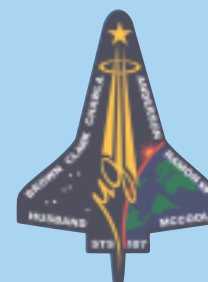
WordFind

Find each of the following words. They can be forward, backward, up, down, diagonal, or straight. (Answers on page 12.)

ACID RAIN	MARS
AIRPLANE	NITROGEN
ATMOSPHERE	OXYGEN
AUTOMOBILE	OZONE
CHEMISTRY	PLANET
CLOUD	RAINBOW
CONTRACTING	ROCKET
EARTH	SATELLITE
EXPANDING	STAR
GAS	VACUUM

Although some word phrases have spaces in the list above, they should appear as compound words within the puzzle, for example, ACIDRAIN.

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



This issue of *Celebrating Chemistry* is dedicated to the astronauts of the Space Shuttle Columbia, STS-107.



Celebrating Chemistry is a publication of the American Chemical Society's (ACS) Office of Community Activities in conjunction with the National Chemistry Week Task Force. The Office of Community Activities is part of the ACS Membership Division. *Celebrating Chemistry* is published annually and is available free of charge through your local National Chemistry Week Coordinator. You can go to chemistry.org/ncw to locate your National Chemistry Week Coordinator or to find out more about National Chemistry Week.

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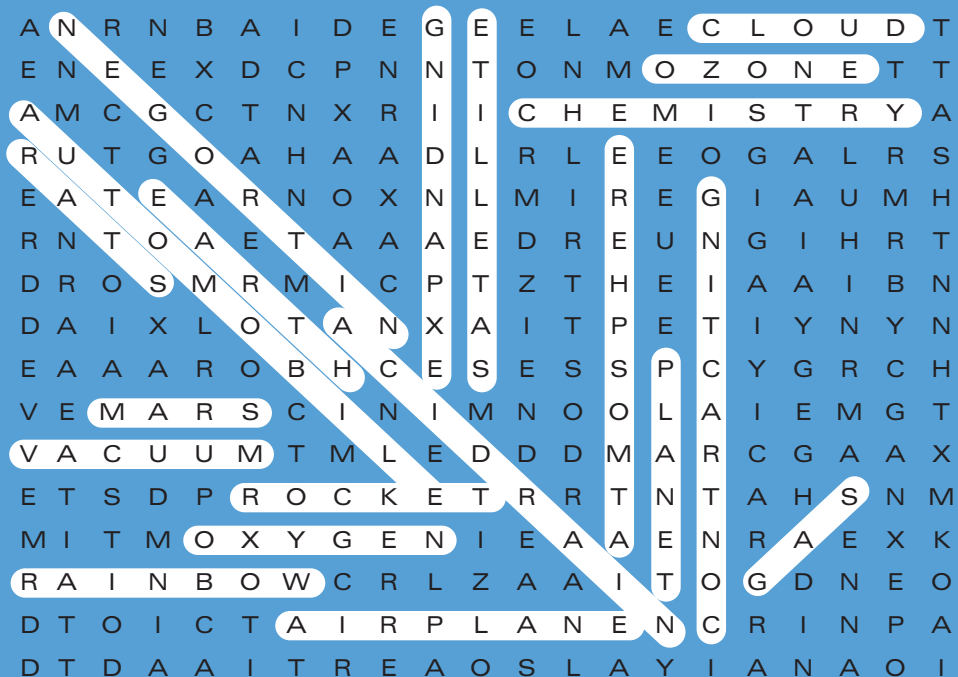
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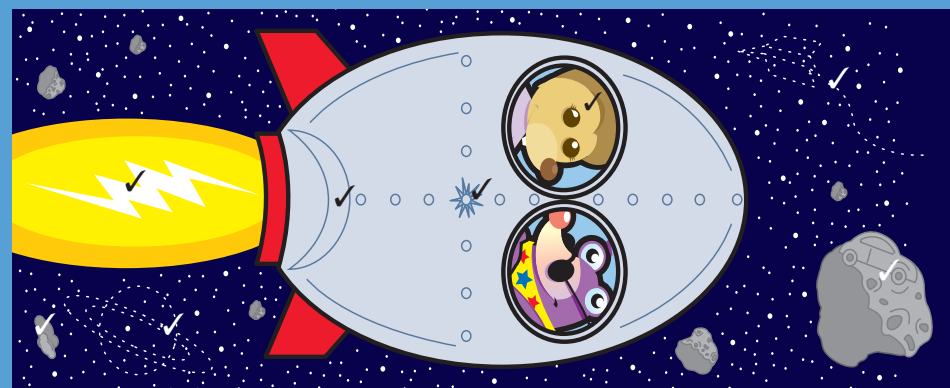
Many of the activities described in this publication were modified from *WonderNet* (chemistry.org/wondernet), a publication of the ACS Education Division. Photos and graphics of planets and spacecraft were furnished by NASA. Photos and graphics for "Timeline: 100 Years of Powered Flight" were furnished by the National Air and Space Museum, Smithsonian Institution.

The activities described in this newspaper 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.

WordFind from page 11



Hidden Objects from page 9



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. The majority of 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. The largest of these outreach programs is National Chemistry Week (NCW). NCW is held every year in the fall. ACS members celebrate NCW by holding events in schools, shopping malls, libraries, science museums, and even train stations!

Activities at these events include, among other things, carrying out chemistry investigations and participating in contests and games. If you would like to know more about how you can participate in National Chemistry Week, please contact us!



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