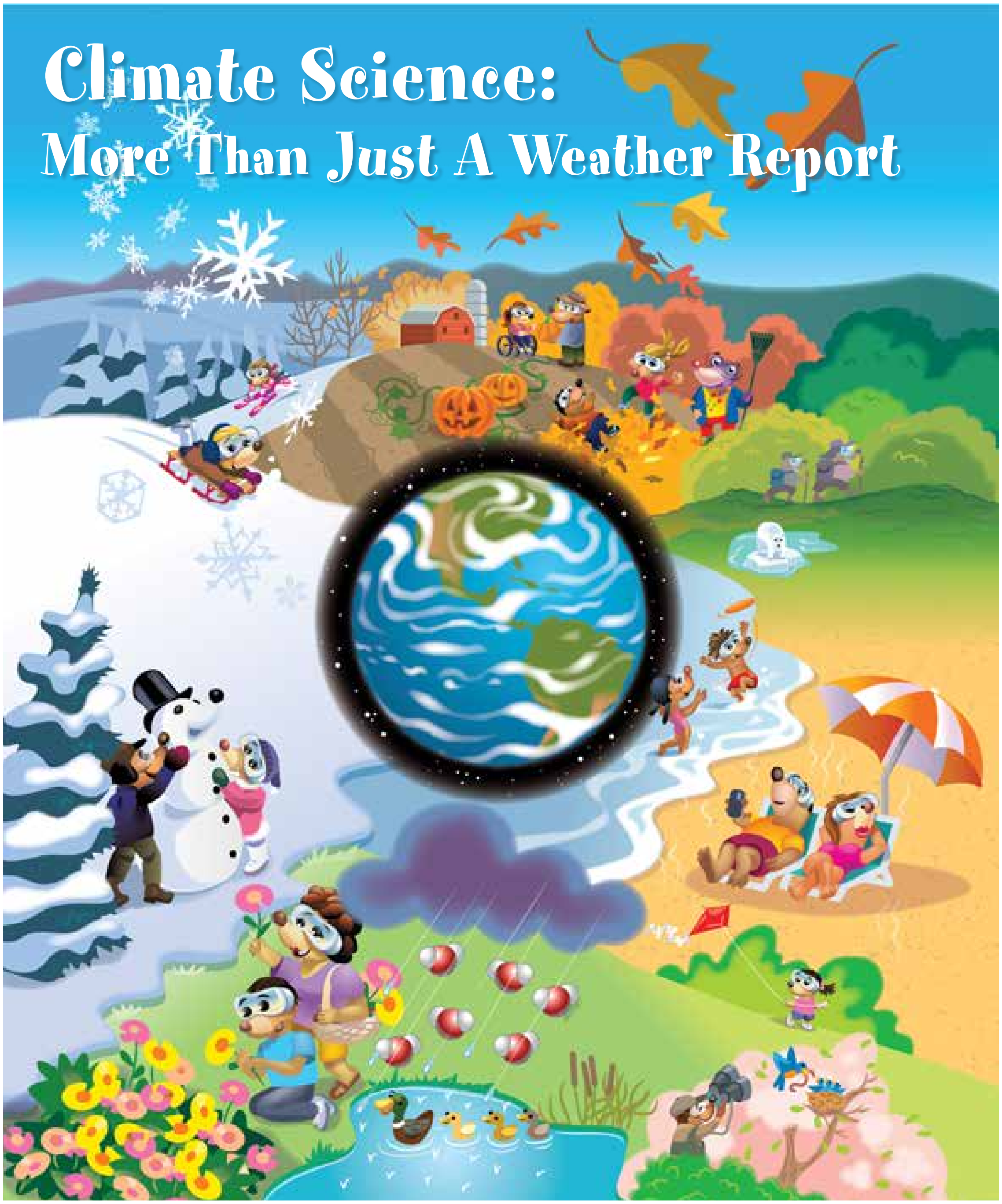
Celebrating Chemistry

CHEMISTS CELEBRATE EARTH DAY AMERICAN CHEMICAL SOCIETY



Climate Science: More Than Just A Weather Report

By George Fisher

Climate science is the study of weather and the conditions that affect the weather we experience at different times of the year, around the world. **Meteorologists** are scientists who have been trained to study and predict weather. It is important that we continue to improve scientific understanding of climate science and how we can predict dangerous, long-term changes in climate.

Climate on earth involves complex interactions between energy from the sun, oceans, land, clouds, rain, and polar ice. Changes in the climate affect our health, environment, and economy, so all life on earth depends on and affects climate.

When sunlight reaches earth, it can be reflected back into space or absorbed by the earth. Light-colored objects such as snow and clouds reflect sunlight. Darker surfaces such as oceans, forests, or soil absorb sunlight. When the sun's energy is reflected, the earth cools. When the sun's energy is absorbed by the earth, the temperature increases, causing icebergs to melt and sea levels to rise.

Climate changes occur through both natural and man-made processes. Natural processes include changes in the sun's energy, shifts in ocean currents, and others. But these natural causes do not fully explain the climate changes such as global warming that have occurred over the last century. Human activities also contribute to climate change.

Billions of tons of **carbon dioxide** (CO_2), **particles** (called aerosols), and other heat-trapping gases (known as **greenhouse gases**) are released into the atmosphere every year (read more about these terms in the following pages). Reducing these air-polluting emissions is one way we can change our climate for the better.

We can prepare for likely climate changes and reduce their effect by processes known as **adaptation**. Examples of adaptation include strengthening water conservation programs, improving stormwater systems, developing early warning systems for extreme heat events, and preparing for stronger storms through better emergency preparation and response strategies.

To learn more about climate science, check out these sources:
http://www.epa.gov/climatechange/science/overview.html
http://cleanet.org/clean/literacy/climate_lit.html

George Fisher, Ph.D. *is Professor of Chemistry, Barry University, Miami, FL.*

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!

What a Cat Knows about Greenhouse Gases!

By George Heard

Cats just love to sit in the window! They always seem to find the warmest spot in the house — and why that happens to be in front of windows has something to do with greenhouse gases. When a window lets in light from the sun, that light can be trapped by the gases in the room. This keeps the light (and heat) from going back out of the window. This trapping of light as heat inside is what happens in a greenhouse, which helps warm-weather plants grow all year round.

We can think of the earth as a big greenhouse as well. Light from the sun comes in through the atmosphere, and some of it is trapped by gases. Some of it gets back out as well … and that's a good thing! If all the light from the sun stayed on earth as heat, it would become too hot for plants to live.

Gases that are good at trapping this light as heat are called greenhouse gases. Some of them are natural, and some are man-made. Most cars have an exhaust pipe that adds a gas called carbon dioxide into the air, and carbon dioxide is really good at trapping that heat.

Greenhouse gases are a tricky balance. If we didn't have any, then Earth would be almost as cold as Mars, where water is frozen all the time. But if we have too many greenhouse gases, then the air would heat up, and that could cause strange weather as more water evaporates into the atmosphere.

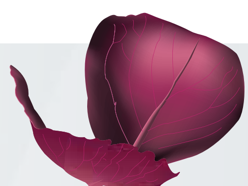
The levels of greenhouse gases can go up and down. A process that makes the level of a greenhouse gas go down is called a **sink**. We need sinks to stop the amount of greenhouse gases from going up and up. Scientists are looking for ways to make sinks for man-made greenhouse gases, and to improve the sinks for gases that are both natural and man-made.

Get to Know Some Greenhouse Gases!

Name of gas	Natural or man-made?	Where does it come from?	What sinks are available?
Water vapor	Natural	Oceans, lakes, rivers	Cold temperatures lead to less water vapor
Carbon dioxide	Both	Rotting mulch (natural), burning fuel (man-made)	Trees and plants
Methane	Both	Marsh gas (natural), farming rice (man-made)	Oxygen and water in the upper atmosphere
Nitrous oxide	Both	Lightning (natural), fertilizer (man-made)	Light in the upper atmosphere
Halocarbons	Man-made	Refrigerators, making electronics	No known sinks

George Heard, Ph.D. *is the Ruth and Leon Feldman Professor of Chemistry at the University of North Carolina Asheville and Chair of the American Chemical Society Committee on Community Activities.*

2 Ways to Make Your Cabbage Juice Indicator … Your Choice!



The Lose the Blues with CO_2 activity on page 6 needs a special liquid called an indicator made from red cabbage. We call it a red cabbage indicator, even though it starts out kind of blue!

Quick Method

1. With the help of your adult partner, put two or three leaves of red cabbage in a blender or food processor.
2. Add ¾ cup (about 175 mL) water. Blend for one minute.
3. Strain through a sieve and retain the liquid. This is your red cabbage indicator.

Note: Any unused portions may be refrigerated for later use.

Soaking Method

1. Tear several leaves of red cabbage into small pieces and place them into a 1- or 2-cup container.
2. Add warm water to the container, stir, cover, and allow to sit until the water becomes uniform in color.
3. Strain the contents and retain the liquid.

Where's the CO_2?

By Alex Madonik

Carbon is the basis of all life on earth, because all living things are made of molecules that contain carbon atoms. Carbon exists in many chemical forms. You are probably familiar with charcoal and graphite in pencils (which do NOT contain the element "lead," by the way). When we burn fuels that contain carbon, such as oil, wood, or gas, **carbon dioxide** (CO_2) is one of the products.

CO_2 is an invisible gas in the air all around us, and can be a natural part of life. For example, plants take CO_2 from the air and use it to make their own food, including sugars, proteins, and fats. Since our bodies can't make our own food, we eat plants to give us energy. Then, when we digest our food, we produce CO_2, which we then exhale in small amounts in our breath. CO_2 dissolves in water, so some of it dissolves in the oceans. Tiny plants and animals in the ocean turn CO_2 into minerals such as **calcium carbonate**, the main ingredient in seashells.

We can't see the CO_2 in the air, but scientists use instruments to measure it. We know the concentration of this gas has risen dramatically over the past 100 years, due to the burning of coal and oil. These fuels were formed from the carbon that existed in plants and animals that lived millions of years ago — that's why they are called "**fossil fuels**."

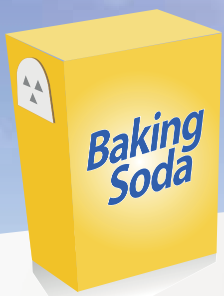
But when there is too much CO_2 in the atmosphere, it can be a problem. More CO_2 in the air means more CO_2 will dissolve in the oceans. This makes the ocean more **acidic**, and that can harm seashells and coral, which dissolve in acid. To see how, have an adult help you take a piece of eggshell (which is made of the same material as seashells) and put it in some vinegar, which is an acid. What happens?

The CO_2 we add to the atmosphere also makes the earth warmer on average. You may already know that it's the sun's light that keeps us warm. This light passes through our atmosphere and is absorbed by the oceans, land, and many things that grow. Some of this energy returns to the air as heat given off by the oceans and the land. This heat travels through the air as **infrared light** — we can't see it, but it warms us, just like a heat lamp. Infrared light can escape from the atmosphere into outer space, but some of it is absorbed by the CO_2 and water vapor in the air. Because this heat can't escape our planet, it stays around, and warms our atmosphere. This is called the "**greenhouse effect**," and we now know that greenhouse gases such as CO_2 can change the climate, or the long-term weather patterns, on the earth.

Scientists want to study the climate of the past … a time long before there were such things as weather reports! They can look at the layers of ice that have collected for hundreds of thousands of years in places such as Greenland and Antarctica. Each layer represents a year's snowfall. These layers trap air bubbles that contain CO_2 and other gases. These bubbles can tell us about the climate long ago.

This article was adapted from:
http://www.acs.org/content/acs/en/climatescience.html

Alex Madonik, Ph.D. *is National Chemistry Week Coordinator for the California Section of ACS.*



Lose the Blues with CO_2!

Carbon dioxide (CO_2) is essential for life on earth. Plants use it to make food for themselves and for animals. Scientists have ways of testing the amount of CO_2 in the atmosphere. In the activity below, you can do your own test for CO_2!

Materials

- 8 ½" x 11" (21.5 cm x 28 cm) sheet of white paper
- Cabbage indicator solution (see preparation on page 3)
- 2 12-ounce (.35 mL) clear plastic cups
- 2 tablespoons (about 30 mL) baking soda
- 2 tablespoons (about 30 mL) vinegar
- A teaspoon and tablespoon
- Empty, disposable, plastic juice bottle, 1 pint (about ½ L) with wide mouth
- 2 straws for stirring
- 1 straw for testing, at least 7" long (about 20 cm)

Procedures

1. Place 2 clear plastic cups on a white piece of paper. Label one cup "control" and the other cup "experimental." Pour approximately 2 tablespoons of the red cabbage indicator solution into each cup.
2. Place about 2 tablespoons of baking soda into the bottle. Add 2 tablespoons of vinegar. Hold your hand gently over the top of the bottle and swirl to mix the vinegar and baking soda. This should produce bubbles of carbon dioxide (CO_2) gas.
3. Very carefully tilt the bottle over one cup so that only the CO_2 gas pours out of the bottle and into the indicator. Be sure that none of the liquid pours into the cup. The CO_2 is invisible, but since it is heavier (denser) than air, it should pour out of the bottle and into the cup of indicator.
4. Use a different straw to stir the indicator solution in each cup. Compare the cup you poured CO_2 into to the control cup. What did you notice? What do you think caused any change you observed?

Safety Suggestions

✓ Follow Milli's Safety Tips on page 2.

✓ Safety goggles required.

✓ Read warning labels on all materials being used.

✓ Be careful to keep all of the materials used away from your mouth, nose, and eyes!

Disposal: Solutions may be poured down the sink and flushed with cold water. Remember to rinse and recycle the plastic cups and bottles!

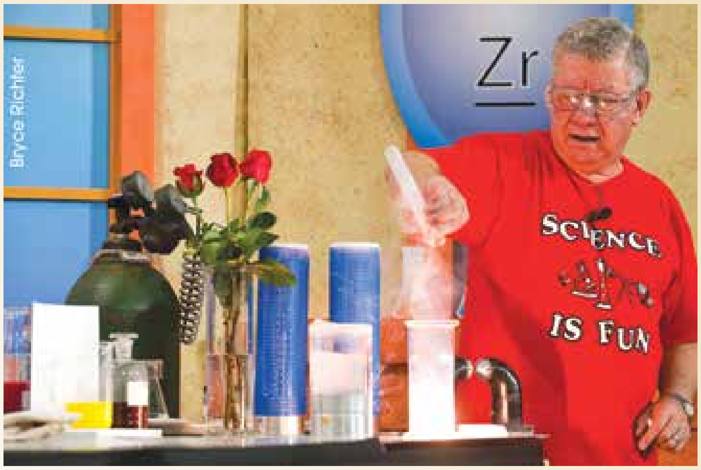
How does it work? Where's the chemistry?

When the carbon dioxide mixes with the water in the cabbage indicator, it creates a very weak acid called **carbonic acid**. This acid reacts with the red cabbage indicator and changes its color from blue-green to red.

What did you see?

If the indicator solution changes color when CO_2 is mixed in with it, what do you think would happen if you used a straw to bubble your own breath into some fresh cabbage indicator solution? Use the LONG straw to try it and see!

The Adventures of Meg A. Mole, Future Chemist



Dr. Bassam Z. Shakhashiri, Professor of Chemistry

My travels this year brought me all the way to Madison, Wisconsin where I met Dr. Bassam Shakhashiri. Dr. Shakhashiri is a professor of chemistry at the University of Wisconsin-Madison. Aside from teaching, he loves to volunteer in the community teaching everyone about how science is fun!

I asked Dr. Shakhashiri to tell me more about his work. He explained, "I work with kids ages 5 to 95 and beyond to share the joy of learning science by doing fun experiments. In my class I have 350 college students. Outside of class I reach thousands of people in person — at shopping malls, conventions, museums, schools and universities — and thousands more on radio, and millions on television and the Internet."

He told me, "I wear my Science Is Fun T-shirt and my Science Is Fun button everywhere I travel. I meet with people at the White House, in the US Congress, at state capitols, in zoos and botanical gardens, and lots of other places around the world.

He added, "I write books to help other teachers explain and demonstrate chemistry to their students. In 2012, I was president of the American Chemical Society! This was a great honor and fantastic opportunity to tell everyone about the beauty of chemistry and what chemists do."

Dr. Shakhashiri told me about his interest in chemistry as a child: "I grew up in Lebanon, and when I was young my mother knitted me a yellow sweater. I loved its bright color. I started to wonder: What makes it yellow? What is yellow? How long will the color last? Will the color match my favorite pants?"

"So many things in our world are colorful: blue sky, white clouds, green trees," said Dr. Shakhashiri. "Color was everywhere, and ever-changing, and I wanted to understand it! As I grew up and studied science, it was very satisfying to learn explanations for my childhood questions."

He enjoyed conducting experiments as a child. With his parents' help, he would safely conduct experiments in the kitchen. He liked "watching color changes, playing with soap bubbles and wondering about their colors and also why they float and pop." Sometimes he even learned how to hook up electric circuits!

Dr. Shakhashiri decided to go into science because he "wanted to understand our beautiful complex world and how scientists can help protect our planet from destruction." His favorite subjects in school were science, religion, and philosophy.

Now that he is an adult, I asked Dr. Shakhashiri what he has enjoyed so much about his job. He told me that he loves to "share fun experiments with children and their parents. I have thousands of letters and drawings from children who have watched my shows in person and on television."

To learn more, he told me I could tell all of my friends to visit his website at www.scifun.org. "You can browse around on our website," he told me, "especially where we have posted experiments you can do at home."

He also told me all about how many children come to his Science is Fun shows, "to see exciting experiments and learn about science. The biggest show takes place every holiday season, and is called 'Once Upon a Christmas Cheery, In the Lab of Shakhashiri.' The event just celebrated its 45th anniversary!"

For those who cannot go to one of his shows, there is a YouTube channel called "WISLscifun" that everyone can visit! I hope everyone checks it out and agrees that Science IS Fun!

Personal Profile

FAVORITE COLOR? Red

FAVORITE PASTIME/HOBBY?
Listening to music

ACCOMPLISHMENT YOU'RE PROUD OF?
My daughter

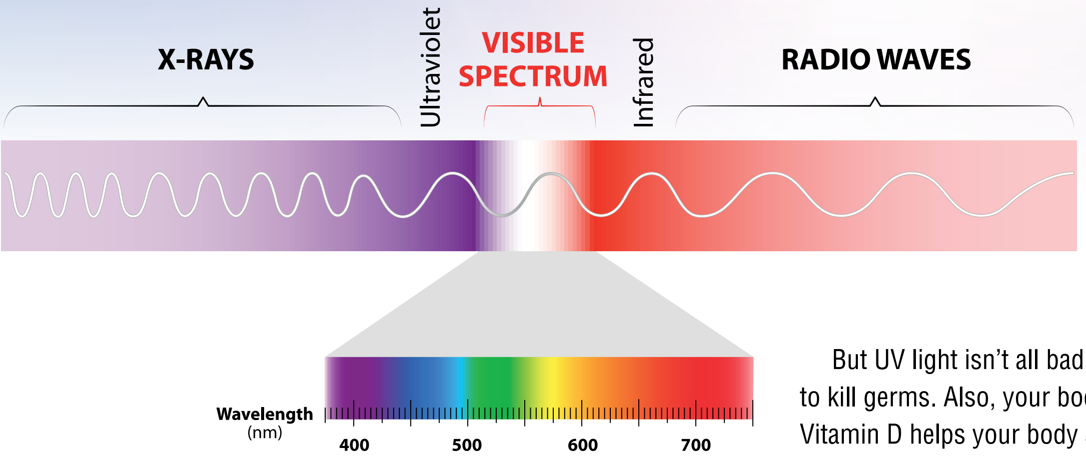
ABOUT YOUR FAMILY?
My wife June and I live in Madison with our dog, Oliver. Our daughter, Elizabeth, (who recently climbed Mount Kilimanjaro!) graduated in 2007 from UW-Madison, and received her law degree from the University of Michigan Law School in Ann Arbor in 2010; she and her husband Bob live in Chicago.

UV Light: Powerful, Invisible Sunlight

By Melissa L. Golden

Have you ever gone outside to play and later realized that you've gotten a sunburn? A sunburn causes the skin to turn red and hurt, and is a type of skin damage caused by **ultraviolet (UV) light**.

Sunlight is made up of some light that we can see and some that we cannot. It contains infrared, visible, and UV light. All of these are types of electromagnetic radiation. Radio waves, microwaves, and X-rays are other types of electromagnetic radiation.



It may seem strange, but light actually moves in tiny waves, similar to waves in an ocean or lake. The distance from the top of one of these waves to the next is called the **wavelength**. UV light has a slightly shorter wavelength than visible light. People can't see it, but some birds and insects can. To help us detect UV light and measure its wavelength, scientists use special chemicals and instruments. The wavelengths of UV light are 10 to 400 nanometers (nm) long, which means that even the longest wavelength of UV light is still 250 times skinnier than a human hair!

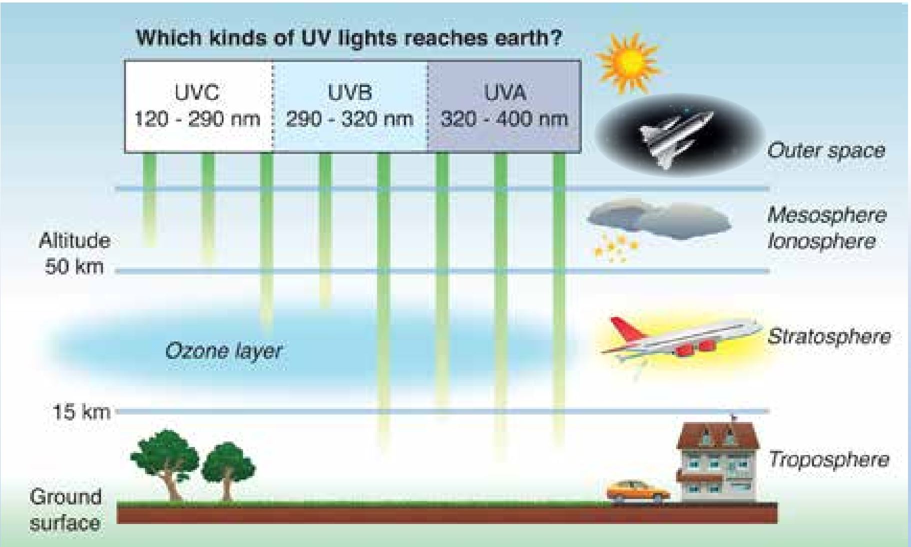
Scientists divide UV light into smaller categories. UVA, UVB, and UVC are three of those smaller categories of UV light that are in sunshine. You may have noticed UVA and UVB on the labels of sunscreen at the store. UVC (100-290 nm in wavelength) is the shortest and most energetic, but most of it gets absorbed by the ozone layer of the earth's atmosphere before it can reach the surface of our planet. That's why you don't see advertisements for sunscreen that protects us from UVC light; the ozone layer does it for free!

UVA (320-400 nm) rays have the longest wavelengths. UVA rays cause suntans and sunburns. But over time they cause your skin to look older than it really is. The skin becomes saggy and doesn't have the ability to stretch and bounce back as younger skin does.

UVB rays (290-320 nm) fall in between UVA and UVC rays. These rays are more energetic than UVA rays and can cause damage to your body such as sunburns, cataracts, and skin cancer. They can also pass through your skin and really hurt the inside of your body. That is why it is important to cover up, wear sunglasses, and use sunscreens with a high SPF. SPF means Sun Protection Factor. The higher the SPF of your sunscreen, the more it blocks UV light to protect your skin.

But UV light isn't all bad. UV light can be used as a disinfectant to kill germs. Also, your body uses UV light to make vitamin D. Vitamin D helps your body absorb calcium and other minerals needed to keep your bones healthy. Without this vitamin, some people feel depressed. That is one of the reasons people associate sunshine with happiness.

__Melissa Golden, Ph.D.__ is Associate Professor of Inorganic Chemistry at California State University Fresno. She uses ultraviolet and visible light to study how different metals can cause changes in living things.



UV Detecting Beads and UV Blockers

By Melissa L. Golden and Joshua Wood

Safety Suggestions

- ✓ Disposal: Plastic bags and paper towels may be placed in the trash. Pill containers may be recycled.
- ✓ Do not eat or drink any of the materials used in this activity.
- ✓ Thoroughly wash hands after this activity.
- ✓ Always spray away from your body and other people.

Introduction

Sunlight doesn't contain only the light we see, called visible light. It also contains a light that our eyes cannot see. That light is called ultraviolet light, or UV light for short. This light is more energetic than visible light, and this extra energy can cause chemical reactions and sunburns.

There are special beads to help us detect UV light. These beads have a material in them that causes them to change colors when exposed to UV light. This experiment explores which products help protect our skin, eyes, and medicine from being damaged by UV light.

Materials

- 1 transparent orange or red prescription pill bottle
- 6 color-changing energy beads (also known as UV beads). These can be purchased online. (If you cannot buy UV beads online, some stores sell nail polishes that change color in the presence of UV light.)
- One pair of sunglasses
- 4 small plastic bags with zipper closures
- 3 sunscreens with different SPF numbers (creams or lotions work best for this activity)
- "Stretch Magic" beading cords, yarn, pipe cleaner, or similar bracelet-making material

Procedures

TEST 1: PILL BOTTLE

1. Take one of your beads, note its color, and place it inside your pill bottle. Make sure you do NOT expose the bead to any sunlight before putting it into the bottle.
2. Replace the lid on the bottle.
3. Walk over to an open window where sunlight comes into the room, or walk outside. Let the sun shine on your pill bottle for at least a minute.
4. Remove the lid from the pill bottle, take out your bead, and examine it. If you are by a window and do not see a difference, go outside to find a sunny spot and try again.

What did you see?

1. Use your power of observation and describe what you saw when the bead was exposed to sunlight.
2. What do your observations tell you about the properties of the orange pill bottle? List your evidence.
3. Why do you think some medicines are stored in orange-colored bottles?

TEST 2: SUNGLASSES

1. Take another bead that has not been exposed to sunlight and place it in your hand.
2. Place a pair of sunglasses in your hand so that the lens covers the bead.
3. Walk over to a window where sun is shining in (or go outside). Let the sun shine on the lens covering the bead in your hand for at least a minute. Observe your bead.
4. Remove the sunglasses and then observe your bead again.

What did you see?

1. Watch closely to see if there is any color change in the bead. What did you see?
2. What does that tell you about the sunglasses? Are they a good UV blocker? Do all sunglasses block UV light? How could you find out? Try it!

TEST 3: SUNSCREEN

Part A

1. While working in a very shaded area, or inside away from a window, take 4 beads, and place one in each of the 4 bags. Label the bags 1, 2, 3, and 4.
2. Spray or add a small drop of one of your sunscreens to the bead in bag number 1, and write the SPF number on the label. Continue this process with the beads in bags 2 and 3, using the other two sunscreens. The bead in bag 4 should have no sunscreen. This is your "control" to use for comparison.
3. Seal each bag and rub the sunscreen onto the beads, making sure that every part of the bead is evenly coated with sunscreen.
4. Take the 4 bags of beads to a place where the sun can shine on them.
5. Compare the beads coated with sunscreens to the bead that was not coated.

What did you see?

1. What happens to the beads with sunscreen with the different SPFs?
2. What does the sunscreen do? Give evidence to support your hypothesis.
3. Rank the beads according to the intensity of their colors. Which bead has the darkest color? Which bead has the lightest color? What does that tell you about how sunscreens with different SPF numbers behave?

Part B

1. Now let's have a little more fun. Gather all 6 beads (you can wipe the sunscreen off the beads using a paper towel). String them together on a piece of the bracelet-making material you're using, and tie off the end to make a bracelet!
2. Be creative! Since your beads turned different colors when activated by UV light, you can arrange them in any order you like!

Explore! Think of other experiments you can do with the beads. Here are some questions you could try to answer. Do the beads change color when it is cloudy? Do the windows in a car block UV light? Be a scientist and try different bead experiments to discover the answers.

How does it work? Where's the chemistry?

The UV light causes a chemical change in the dye that is in the beads and makes them change color. This is how we can use the beads to detect UV light. You have probably seen several products that help protect us from damaging UV rays.

- **Pill bottles** are great at blocking UV light, even though you can see through the bottles. People use these bottles to protect some medicines from being damaged by UV light, so that the medicines can do their job.
- **Sunglasses** can keep bright sunlight out of our eyes, and they also protect our eyes from damaging UV rays.
- **Sunscreens** help block damaging UV rays so that people don't get sunburned. Sunscreens have special chemicals in them that prevent skin cancer by absorbing the UV light and keeping it from going through your skin.

Particles and Climate Change

By Janet A. Asper

As you've seen in this issue of *Celebrating Chemistry*, climate change is more complicated than just the weather, and many different things contribute to it.

A lot of people talk about CO_2 and climate change — but CO_2 isn't the only cause of the problem. Another piece of the puzzle is particulate matter, also known as aerosols.

Particulate matter refers to the tiny pieces of solid or liquid that float in the air. These pieces are much smaller than the width of a human hair! Some particulate matter comes from nature, such as the salt spray from the oceans, volcanic eruptions, dust from dry fields, or even certain oils from pine trees. Other particulate matter is caused by the actions of people — mostly, when they burn fossil fuels.

The weird thing about particles is that some of them cool the earth, and some warm it. It all depends on what happens when the energy from the sun hits the particles. Light-colored or translucent particles will reflect the sun's energy away from the earth, helping to cool it. Dark particles absorb heat, warming the atmosphere.

Burning wood, leaves, or fossil fuels makes dark particulates. Burning fossil fuels also can produce nitrogen and sulfur-based gases. Those gases attract water and other molecules, forming light-colored particulates. Since particles can both warm and cool the earth, you can see that their effect on the climate is complicated—so scientists are working to figure it all out!

What can you and your family do about particulate matter?

Conserve energy: Coal-fired power plants, where most of our electricity comes from, can contribute to particulate matter. So the less energy you use, the fewer particulates that go into the atmosphere!

Avoid burning leaves and yard waste: The soot from burning leaves is dark particulate matter. Compost the leaves instead … they make good fertilizer!

Use clean machines: Keep gas- and diesel-powered equipment, like cars and lawn mowers, in good working condition so that they burn fuel more cleanly.

Janet A. Asper, Ph.D. *is Associate Professor of Chemistry at the University of Mary Washington, Fredericksburg, VA.*

Word Search

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

E	A	F	M	L	I	E	A	A	T	S	T	A	I	E	S	I
E	I	A	O	T	O	H	E	H	E	R	N	O	H	C	L	H
O	G	O	O	E	N	N	M	A	I	S	A	E	E	C	H	A
O	R	N	H	S	D	I	T	S	L	N	C	E	L	A	I	U
R	E	T	T	A	M	E	T	A	L	U	C	I	T	R	A	P
I	E	P	C	T	F	N	S	R	E	D	M	S	P	B	N	D
C	N	S	D	H	L	T	O	R	O	A	A	R	S	O	D	S
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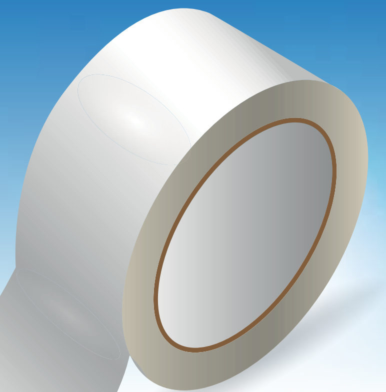
R	E	S	D	L	A	S	I	N	N	B	A	I	E	T	S	T
L	S	T	S	I	G	O	L	O	R	O	E	T	E	M	R	V

CLIMATE SCIENCE
METEOROLOGISTS
CARBON DIOXIDE
OXYGEN
NITROGEN
PARTICULATE MATTER
AIR PRESSURE
UV LIGHT
GREENHOUSE GASES
FOSSIL FUELS

For answers to the Word Search, please visit the Educational Resources page at www.acs.org/earthday.



Collecting Particles From Air

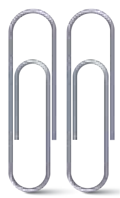
By George Fisher

Introduction

The air we breathe contains particles that we don't normally notice. Air conditioners and furnaces in our houses have filters to trap these particles in the air so that we don't accidentally breathe them in. Let's see if we can trap some of these particles from inside and outside your home.

Materials

- Two 3" x 5" (7 cm x 12.5 cm) index cards
- Two paper clips
- Double-sided/double-stick tape
- Magnifying glass



Procedures

1. Label the ruled side of one card "**inside**" and label the unruled side of the ruled card "**outside**."
2. Punch a small hole in a corner of both cards and insert one paperclip in each hole.
3. Cover the unruled side of each card with strips of the double stick tape.
4. Hang one card somewhere inside your house and hang the other card outside.
5. Collect the cards after one or two days.
6. Examine each card with a magnifying glass and record the number of particles that have been collected on each card. Also, write down the shapes and sizes of the particles you collected.

SAFETY

✓ Be careful when punching holes in paper cards.

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

The sticky tape will trap some particles in the air on the index cards. There is no real chemistry associated with this activity, but it does show you that air contains different types of particles. These particles in the air can affect the climate. Dark particles absorb energy and warm the atmosphere, while light particles reflect energy and cool the atmosphere.

What did you see?

Which card, **inside** or **outside**, collected the most particles?

Examine the types of particles collected on each card. Compare and contrast the size and shapes of the particles collected on the two cards.

What can you learn about the how clean the air is **inside** and **outside**? Make a claim about the air inside your house and outside. What is your evidence?

Words to Know

Climate science: the study, over long periods of time, of weather patterns and the conditions that contribute to the types of weather we experience.

Meteorologists: scientists who study weather and predict conditions of temperature, humidity, precipitation, and wind in the near future for a certain area.

Carbon dioxide: also written as CO_2, this is an invisible gas found naturally in small amounts in our atmosphere. It is produced when animals exhale, fossil fuels are burned, volcanos erupt, and plants decay.

Oxygen and **nitrogen:** gases that make up most of the air we breathe.

Particulate matter: tiny pieces of solid or liquid that float in the air.

Air pressure: the force of air pressing on everything at the earth's surface.

UV light: ultraviolet rays emitted by the sun that cause sunburn.

Greenhouse gases: heat-trapping gases in the air.

Fossil fuels: substances formed from carbon that existed in plants and animals that lived millions of years ago. Examples of fossil fuels include coal, oil, and natural gas.

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. Limited copies are available free of charge through your local section's Chemists Celebrate Earth Day and National Chemistry Week Coordinators.

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 158,000 members. ACS members live in the United States and different countries around the world. Members of the ACS share ideas with each other and learn about important discoveries in chemistry during scientific meetings held around the United States several times a year, through the use of the ACS website, and through the many peer-reviewed scientific journals the ACS publishes. The members of the ACS carry out many programs that help the public learn about chemistry. One of these programs is Chemists Celebrate Earth Day, held annually on April 22. Another of these programs is National Chemistry Week, held annually the fourth week of October. ACS members celebrate by holding events in schools, shopping malls, science museums, libraries, and even train stations! Activities at these events include carrying out chemistry investigations and participating in contests and games. If you'd like more information about these programs, please contact us at **outreach@acs.org**.

PRODUCTION TEAM

Alvin Collins III, Editor
Rhonda Saunders, RS Graphx, Inc., Layout and Design
Jim Starr, Illustration
Eric Stewart, Copyediting
Aviva Westheim, Puzzle Design

TECHNICAL AND SAFETY REVIEW TEAM

Michael Tinnesand, Scientific Adviser
Lynn Hogue, Consultant, Committee on Community Activities
George Heard, Chair, Committee on Community Activities

CHEMISTS CELEBRATE EARTH DAY THEME TEAM

George Fisher, Chair
Janet Asper
Chris Ciolli
Melissa Golden
George Heard
Sheila Kanodia
Ressano Machado
Alex Madonik
Analice Sowell
Sanda Sun

DIVISION OF MEMBERSHIP AND SCIENTIFIC ADVANCEMENT

Denise Creech, Director
John Katz, Director, Member Communities
Alvin Collins III, Manager, Volunteer Support

ACKNOWLEDGEMENTS

Meg A. Mole's interview was written by **Kara Allen**.

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.