

Air Quality Outline

Big Idea

Pollutants in our atmosphere affect the health of organisms in a negative way and can be prevented.

Essential Questions

- How do chemical pollutants in our atmosphere reach the surface of the Earth?
- Where are the sources of the pollutants that are found in our air?
- How do these pollutants affect organisms?
- In what ways can humans prevent the production of harmful atmospheric pollutants?

Vocabulary

- Acid rain—rain that contains acidic chemical compounds from the burning of fossil fuels and is harmful to the environment.
- Cilia—a tiny projecting thread on a cell or organism; in humans they are found lining the trachea, where they sweep mucus and dirt out of the lungs.
- Chemical bond—a force that binds atoms together to form molecules
- Leeching—to pull or draw out
- Particulate matter (PM)—PM comes from dirt roads, farming operations, industrial crushing and grinding, and windblown dust, among other sources. Combustion of fossil fuels, as well as burning garbage and agricultural products, also releases particulate matter into the air. Additionally, PM can be formed when chemicals such as NO_x, sulfur dioxides, and others (including many of the same that form ozone) react and condense in the atmosphere. This PM is the reason for haze and reduces visibility—no more beautiful views of the mountains. 85% of our electricity in the eastern United States comes from burning coal.
- pH scale—a measurement of acidity on a scale of 0 (acidic) through 7 (neutral) to 14 (alkaline)
- NO_x (Nitrogen Oxides)—NOx comes from fuel combustion, both in motor vehicles and industrial processes. Power plants, factories, cars, trucks, and stationary engines all create NOx.
- SO₂—Sulfur dioxide is emitted from burning fossil fuels like coal. About 2/3 of all sulfur dioxide emissions come from the burning of coal.
- VOCs (Volatile Organic Compounds)—VOC's generally come from evaporated petroleum products. The main sources of VOCs are pesticides and fertilizers, motor vehicles, farming operations, petroleum production facilities, surface coatings, and solvents.

Air Quality Outline

Lesson Outline

- Introduction
- Air Pollution Play—The Sinister Seven
- What Is Air Pollution and Where Does It Come From?
- What's the Big Deal With Acids and Bases?
- Acid Rain Game
- How is this Affecting the Smokies—There Aren't Any Smokestacks?
- Keep the Calcium game
- Does It Affect Human Health?
- Scavenger Hunt
- Conclusion: Do I Create Air Pollution?

Optional Activities

- Smog In a Jar
- Video from Forecast Earth

Air Quality Activities



INTRODUCTION

15 Minutes

Ask the students, “what is air?” (a mixture of nitrogen, oxygen, and minute amounts of other gases that surround the earth and form its atmosphere) The quality of our air is very important for several reasons. Ask the students what depends on air (plants, trees animals, insects, fish, bacteria (decomposition) and us!)

Great Smoky Mountains National Park has been designated an International Biosphere Reserve. It is one of a few chosen places that received this special level of protection because it has so much biodiversity, and so many different types of living things.

Ask the students if they can think of any large cities in the southeast and mid-western United States, maybe a city that they are from. (Atlanta, GA; Birmingham, AL; Huntsville, AL; Nashville and Knoxville, TN; Cincinnati, OH) You may even want to use the pull-down map in the dining hall to show where these places are. Cities need a way to provide electricity for their residents, and people need to drive to work and school. When we use fuel, like coal or gasoline, chemicals are released into the air. Even though Great Smoky Mountains National Park is not near a large city, the air moves and polluted air settles over the mountains. We are going to talk about some harmful pollutants in the air, what we can do to make these mountains healthier, and what we can do to make the air around our home cleaner.



AIR POLLUTION PLAY—The Sinister Seven

20 Minutes

Lead In

Your students can learn about some of the major and most common air pollutants by putting on this play. By performing the play, they can teach each other about the pollution problems in our atmosphere, and how we can make our air cleaner.

We are going to put on a play to help us teach each other about the different types of air pollution.

Procedures

- Assign characters (there are 24 parts—enough for each student to have a character. If there is a smaller group then a student can play all the Toxins, or all the Particulates, etc).
- Have the class quietly read the play to familiarize themselves with their character

Air Quality Activities

Wrap Up

- Perform the play
- Conclude with a summary of the pollutants, and a discussion about how we all can make our air cleaner



WHAT IS AIR POLLUTION AND WHERE DOES IT COME FROM?

20 Minutes

This activity can be condensed and used as a summary of the pollutants if the play (The Sinister Seven) is performed.

Teacher's Note: You may want to check out this Web page with your students in your classroom for some short movies that help explain a couple of these different pollutants: ozone and particulate matter <http://www.airnow.gov/index.cfm?action=movies.index>

Lead In

What are the sources of the pollutants that are found in our air?

Procedures

There are several cards, each showing a picture of different ways pollutants are emitted into the air. Go over the following pollutants so that students are familiar with they different chemicals:

- VOCs (Volatile Organic Compounds)—Card with tractor spraying pesticides and exhaust coming out of tailpipe. VOC's generally come from evaporated petroleum products. The main sources of VOCs are pesticides and fertilizers, motor vehicles, farming operations, petroleum production facilities, surface coatings, and solvents.
- NOx (Nitrogen Oxides)—Card with power plant and car with exhaust. NOx comes from fuel combustion, both in motor vehicles and industrial processes. Power plants, factories, cars, trucks, and stationary engines all create NOx.
- Particulate matter (PM)—Garbage can with flames coming out and smoke. PM comes from dirt roads, farming operations, industrial crushing and grinding, and windblown dust, among other sources. Combustion of fossil fuels, as well as burning garbage and agricultural products, also releases particulate matter into the air. Additionally, PM can be formed when chemicals such as NOx, sulfur dioxides, and others (including many of the same that form ozone) react and condense in the atmosphere. This PM is the reason for haze and reduces visibility—no more beautiful views of the mountains. Thirty-seven percent of our electricity in the United States comes from burning coal (2012).

Air Quality Activities

- SO₂—Card with coal power plant. Sulfur dioxide is emitted from burning fossil fuels like coal. About 2/3 of all sulfur dioxide emissions come from the burning of coal.
- Next, explain that when certain pollutants come in contact with sunshine or water, a reaction occurs and can cause another pollutant. For this step use a mixing bowl and a spoon. Explain the following reactions and the pollutants that are made. You may want the students to “stir the pot” as the pollutants are created.
- O₃ or Bad Ozone—When NO_x (nitrogen oxides from fuel combustion) and VOCs (from pesticides and fertilizers) are in contact with sunshine ozone is formed. This is not the good ozone in the atmosphere, as in the ozone layer (which absorbs ultraviolet radiation from the sun that can be harmful to Earth).
- Acid Rain/Deposition—When NO_x (from fuel combustion) and SO₂ (from coal fired power plants) mix with water (rain). This makes the streams, lakes, ponds more acidic. What will happen to the fish when their habitat is too acidic? Or the plants? Or the salamanders? If the students have already seen a salamander in a previous class you may remind them that salamanders are bio-indicators—meaning that they are organisms that help show the healthiness of an ecosystem. If there are lots of salamanders then that habitat is pretty healthy. If the salamander population is low then that may mean that the habitat is too acidic.
- Particulate Pollution (HAZE)—Particulate matter (PM) card plus NO_x and SO₂ (a combination of dust and particles come in contact with car exhaust and coal burning power plants).

Wrap Up

Now that we know of different types of pollutants and where they come from we are going to explore how they affect the ecosystem. Tell the students that we are going to play some games to help us better understand how important a clean habitat is.



WHAT'S THE BIG DEAL WITH ACIDS AND BASES?

10 Minutes

Lead In

We are going to look at how pH (parts of Hydrogen) might affect different plants and animals.

Procedures

- Ask the students if they know what a pH scale is? (Basically, a range of acidity, 0 being the most acidic, 7 being in the middle or neutral, and 14 being very basic, or alkaline)

Air Quality Activities

- Hand out the pH scale sheet and discuss how different plants and animals are adapted to live in different environments.
- Ask the students what is in soil? (leaves, dead organisms, rocks, minerals) There is something very useful in soil called calcium. Calcium is a mineral that is also important to our own bodies. Where do we get calcium? (milk, cheese, yogurt, ice cream!) Calcium is important to plants and animals. Plants, like grass and trees, take up calcium from the soil with their roots. When animals like cows or snails eat the plants, they take the calcium into their own bodies.

Wrap Up

Continue to explain to the students that when the soil becomes acidic, due to acid rain, the acids actually end up taking the calcium out of the soil. In a bit we will play a game that demonstrates the importance of calcium in soil.



ACID RAIN GAME

20 Minutes

Lead In

How does this acid get into the ecosystems? In this game we will look at how SO₂ and NO_X are produced by power plants and how scrubbers, which can be installed in smokestacks, can reduce the amount of pollutants coming from that power plant. The idea of a buffer is also introduced. Buffers can be found naturally in the environment (limestone rock) or introduced to an acidic area by humans (powdered limestone dumped into lakes).

Procedures

For a group of 20 students, use the following materials and hand out the arm bands.

- SO₂ wears a red arm band (4)
- NO_X wears a red arm band (4)
- H₂O wears a blue arm band (6)
- Fish stand in the “river” area (6)
- Whistle
- Fish Data Sheets
- Scrubber wears a yellow arm band (1)

Have the students tie their arm bands on to show their “character.” Explain to the students that when SO₂ or NO_X is partnered with H₂O it forms acid rain. These new compounds called H₂SO₄ are sulfuric acid and HNO₃ is nitric acid. What do we know about acids? (deteriorates

Air Quality Activities

cars, damages trees at high elevations, causes lakes and streams to become more acidic thus making conditions unsuitable for certain species) Designate students to be fish and have them stand in the playing area designated as the river.

Play round one by having all of the SO₂ and NOX students lined up inside the “smokestack” (one side of a playing field) and have the rest of the students (H₂O and fish) inside the playing field, or river, scattered around. When you blow the whistle have the chemicals come out of the smokestack and try and tag an H₂O molecule. When they tag an H₂O molecule they need to link arms to show they are now acid rain. As a pair they must now work together to tag a fish. If a fish is tagged, they must sit down in the “dead fish zone”. Stop the game after a few minutes to see how many fish are dead and how many are alive. Record this on the Fish Data Sheet.

Before playing round two, explain that scrubbers can be installed on smokestacks to remove SO₂. Have one student become a scrubber and attach a yellow arm band. They must stand a few feet in front of the smoke stack and can try and tag the SO₂ and NOX as they come out. If they are tagged they must go back inside the smokestack and count to 10 before they come out again. Play for the same amount of time and then stop the game and record the number of dead and alive fish on the Fish Data Sheet.

For round three explain buffers. These are substances that neutralize an acid. To play round three keep the scrubber and add a buffer. Attach the yellow arm band to the buffer. This student can only tag acid rain partners. If the partners are tagged they much separate and resume their roles as H₂O, SO₂ or NOX. The buffer should escort the SO₂ or NOX back to the smokestack before tagging another acid rain pair. After about the same amount of time stop the game and record the information on the Fish Data Sheet.

Wrap Up

Discuss with the students why the number of dead fish decreased as the scrubbers and buffers are introduced. Why don't power plants ALWAYS install scrubbers to their power plants? (expensive—means less profit) What are some of the limitations of buffers and using them in the environment? (expensive, powder buffers need to be flown in to lakes and dumped and will also need to be re-applied) Discuss how acid deposition is not a one-day thing but that it is constantly building up in the environment, and the environment is becoming more and more acidic. Plants and animals that can tolerate a small amount of acid may do alright at first but as the acidity increased, they become more

Air Quality Activities

stressed.



HOW IS THIS AFFECTING THE SMOKIES—THERE AREN'T ANY SMOKESTACKS?

10 Minutes

Lead In

Wind patterns in atmosphere and terrain (mountains) cause pollutants to drift eastward and they collect or are trapped in the mountains.

Procedures

To illustrate how pollution can travel, have students line up with their backs toward you. Try and stand up wind of the students and peel an orange or spray a perfume. Have students raise their hand when they can smell it. How is it that they can smell the orange/perfume so quickly?

Wrap Up

Air currents (the heating and cooling of the air around us) are constantly moving the air. This is how the air moves on a global scale. Go in to the dining hall and use the map of the United States. Point out where Great Smoky Mountains National Park is located. Stick the coal power plant pictures on the map to show where most of the coal fire power plants are located. Use the city cards to illustrate where several large cities are located. Ask students which direction the wind usually blows in the U.S. (From Northwest to Southeast or from Southwest to Northeast) What do the mountains do to all of this pollution? (It traps the pollution against the mountains.) This is why Great Smoky Mountains National Park has such poor air quality even though we don't produce much pollution in this area.



KEEP THE CALCIUM

15 Minutes

Lead In

Does pollution enter the food chain? YES! Acids leach out the calcium in the soils, plants can't take up the calcium, snails that feed on the plants don't have as much calcium to form shells, birds that feed on the snails may not have as much calcium in their diet (they eat a lot of snails) to form eggs in their bodies, or they may produce brittle eggs.

Procedures

Scatter the ladybug/leaves collection on the playing field. These represent the minerals that plants and animals take into their systems. For each round of play you will need to change the color that calcium and aluminum represent (the students will catch on and will only collect one color to avoid being killed off). Divide the students into the following groups:

Air Quality Activities

- Snails – 4
- Birds – 2
- Plants – remaining students

Review the food chain using these organisms. At higher elevations in the Smoky Mountains, some birds get most of their calcium from the consumption of snails. Snails feed on the leaves of plants by using a mouthpart called a rasp to scrape the top layer off of leaves. The calcium in these leaves helps them to form a sturdy shell, which protects them. The plants pull in calcium through their roots from the soil and store it in their leaves.

To play, have the plant characters go out onto the field and gather up as many minerals (foam ladybug/leaf shapes) as they can. After a few minutes, send the snail characters out to eat the plants. The snails ‘eat’ the plants by tagging them. The plant then needs to turn over all the minerals they collected to the snail. After the snails have had a chance to “eat,” send out the birds. They can tag snails or remaining plants. The snail or plant needs to turn over all of their minerals to the bird. Stop the game and have all the students gather in a circle. The students that have collected minerals need to separate them by color. Let the students know that ladybugs are calcium and leaves are aluminum (acid) that pulls the calcium from the soil and makes it unavailable for plants and animals. Every green leaf cancels out a ladybug and makes it unavailable. By looking at the students’ piles, come up with a number that will “kill off” some of the birds. For example, tell the students that if they have 3 or fewer calcium (ladybugs) left, then they did not have enough calcium to form the shell for eggs and are not able to lay eggs this year. If a snail remains, you can say that they do not have enough calcium to produce a sturdy shell and they die of disease because their shell has been damaged.

This game can be played in several rounds. The first round only put out ladybugs. Every bird would make it and be able to reproduce. If each adult bird produces 2 healthy babies a year, students can see that the population will be healthy. The next round you can introduce a coal plant without scrubbers. Add a lot of green leaves and see how the population will be affected because the birds will not be able to reproduce. The last round you can add scrubbers to the coal plant or shut the plant down because a wind farm and solar panels will take the plant’s place for the production of electricity. Take away all but a few of the green leaves and see how the junco population would increase.

Air Quality Activities

Wrap Up



Discuss how the decisions we make everyday can have a real affect on plants and animals. We have just acted out one real food chain and a real situation here in Great Smoky Mountains National Park. Researchers have found that calcium levels are decreasing in the environment and that snails are not able to store as much calcium. Researchers are concerned that this is going to have a real affect on the bird populations, especially at high elevations in the park.

DOES IT AFFECT HUMAN HEALTH?

10 Minutes

Lead In

If air quality is affecting plants and animals, do you think that it affects humans? Yes! We are going to look at some of the effects that air pollution has on our lungs and look at what the air quality looks like for us today.

Procedures

Pass out air quality and human health sheets and review together. On these sheets it shows how air quality affects people with heart problems, asthma and other respiratory issues. Check out this website to see what the air quality rating is for that day.

- <http://cfpub.epa.gov/airnow/index.cfm?action=airnow.national>

You can look at air quality in the Park at two sites:

- Llood Rock: <http://www.nature.nps.gov/air/webcams/parks/grsmcam/grsmcam.cfm>
- Purchase Knob: <http://www.nature.nps.gov/air/webcams/parks/grsmpkcam/grsmpkcam.cfm>

What is the warning system for when the air quality is unhealthy to breathe? (Air Quality Index: <http://www.airnow.gov/?action=aqibasics.aqi>)

Wrap Up



Do you know anyone with any of these issues? Do you think that by

making good decisions and reducing the amount of air pollutants we

can help reduce the heath problems of people with these issues?

AIR QUALITY SCAVENGER HUNT

45 Minutes

Lead In

So, what have we learned so far? Here's an opportunity for the students to test their knowledge of how air pollution is created, how it affects our health, and what we can do to reduce air pollution.

Air Quality Activities

Procedures

Break students into five teams—a Red Team, Blue Team, Green Team, Purple Team, and Black Team. (If you have too few students—less than 10—make fewer teams.) Each group is given a card with 10 questions on it. The cards all contain the same 10 questions, though not in the same order; additionally, the correct answer for each question is in a different location for each team. The students should be told that simply following another team will result in wrong answers for every question.

The students are to read each question, decide on the correct answer, and then walk to the part of campus listed on the card.

Example: Question #3: Tremont is located in: a) Great Smoky Mountains National Park (go to the Council House) b) Denali National Park (go to the Friendship Circle) c) the Maze District of Canyonlands National Park (go to the Pavilion).

In the example above, the correct answer is (a), and the students would proceed to the Council House. When the students reach the location, they'll find a card with a table of letters (see the example below). The students are to find the column that contains their team name (Red Team, Blue Team, etc.), then the row for the question they are answering, and write down the letter they find in that box.

	GREEN	BLUE	RED	PURPLE	BLACK
#1	L	W	E	P	P
#2	R	E	D	O	Y
#3	H	L	F	L	U

Since the example question above was Question #3, the Green Team would write down "H", the Blue Team an "L", and so forth.

Once the students have written down the letter they find, they'll proceed to the next question until they've completed all 10 questions. Once finished, they should return immediately to their original meeting location.

As the groups return, check their answers against the answer sheet. If they have any of the questions wrong, send them back out to try those questions again. Because of the way this scavenger hunt is designed, one wrong answer will not make all of the answers that follow incorrect; the students can simply return to any individual questions that were incorrect, *they do not need to repeat the entire scavenger hunt*.

Air Quality Activities

Once a team has returned with all of their answers correct, set them to work unscrambling the letters to words associated with air quality. The final answer for each team is a pair of words, totaling 10 letters. See the Answer Sheet document in the Resources and Printable Pages. If the students are struggling, help them along with hints.

Conclusion

Go through each of the questions, reviewing the correct answers. Give the students ample time to discuss questions they didn't understand. Several of the questions deal with ways to improve air quality—you may choose to brainstorm with the group to find other possible answers not listed on their cards.



DO I CREATE AIR POLLUTION?

10 Minutes

Lead In

What can I do? I'm not a huge power plant and I can't drive (at least not yet). Let's discuss some ways we use energy each day. Once we recognize how we use energy, we can find ways to reduce the amount of energy we use.

Procedures

Review the list of items by asking students for a show of hands if they did or used these things. You can also have the students grouped in small groups and give them a sheet of paper. Give them about 5 to 10 minutes to come up with a list of ways they use energy. Allow each group to share their list.

Did an electric alarm clock ring? If so, you have already produced a tiny piece of air pollution as a power plant had to burn a fossil fuel (Do you know the fossil fuels? They are: coal, oil, and gas) to make the electricity for the clock to work. Every time we burn fossil fuels this produces air pollution.

Did you take a shower, use a blow dryer, have toast for breakfast? Anytime that you use electricity, you create a little air pollution. How did you get to school? If you walked, rode a bike or skateboard, or used rollerblades you did a great job and produced no air pollution.

Did you ride the bus or ride with friends? This is often called ride-sharing. If you did rideshare, you made some pollution, but you get to share it with the friends you traveled with so you still did a good job!

Did your mom or dad drive you to school? This produced the most pollution! This is because the journey was made just for you and so you

Air Quality Activities

do not get to share the amount of pollution with everyone else traveling in the vehicle.

Wrap Up

Now that we see how we use energy, how can we save energy or reduce the amount of energy we use? Now, you can go over the list below with the group or have the students return to their small groups. Next to each of the ways they used energy, have them come up with ways they could reduce their energy consumption. Allow students to share their energy conservation measures with the group.

- bike or walk to nearby destinations
- ride the bus
- roller blade or skateboard
- drive less (carpool, combine errands into one trip)
- avoid idling (turning off and starting an engine uses less gasoline than letting it idle for more than 30 seconds, i.e. while waiting in line at railroad crossings and drive-thru windows.)
- plant a tree
- conserve electricity
- turn the lights out whenever you leave a room
- use cold water instead of hot whenever possible
- use fans instead of A/C
- reduce, reuse, then recycle
- select products with less packaging (Packaging consumes energy when it's made, generates harmful volatile organic compounds when it's printed, produces carbon dioxide and carbon monoxide when it's burned, and generates greenhouse gases when thrown away in a landfill.)
- buy and use products in their non-aerosol form (propellants used in aerosol cans contribute to pollution)
- buy and use recycled products
- use your fireplace less
- garden organically
- make a compost
- stay on paved roads whenever possible (Driving on dirt roads raises dust which contributes to haze and airborne particulate matter.)

Air Quality Activities

- take cloth bags to the grocery store instead of using plastic that is made from petroleum
- use plastic water bottles over and over and recycle when finished
- pack your school lunch in reusable containers

OPTIONAL ACTIVITIES

Smog In a Jar*

Teachers' Note: The purpose of this experiment is to demonstrate to students how pollution and smog are formed by creating a miniature "smoggy" environment in a glass jar.

Lead In

When factories burn certain fuels, like coal, and cars and trucks burn gasoline and diesel fuel, emissions are released into the air—this is called “pollution.” When pollution mixes with tiny droplets of water in the air and carbon dioxide, it forms a dirty and smelly fog called “smog,” which is very harmful to plants, animals, and people, too. Although smog is usually found in and around large cities, it can be carried by the wind to other areas as well.

Materials:

- Glass jar
- Water
- Aluminum foil
- Ice cubes
- Paper
- Rubber band
- Scissors
- Matches

Procedures

Cut a strip of paper about 10 inches by $\frac{1}{2}$ inch, then fold the strip in half along its length and twist the paper. Make sure the area is clear and the matches, scissors, and any other hazards are safely out of students’ reach.

Using the aluminum foil, make a lid that will seal the glass jar and set it aside (you will use this is a later step).

Pour enough water into the jar to swirl it around and wet the inside. When you are sure the entire inside surface of the jar is wet, pour out the remaining water.

Place three ice cubes on top of the foil lid to make it cold.

Light the paper strip on fire and immediately drop it (and the match)

Air Quality Activities

into the jar. Quickly place the foil lid on top of the jar and seal tightly with the rubber band. Keep the ice cubes on top of the foil.

Have your students draw pictures and discuss what they see forming in the jar.

Wrap Up

When we burn certain things, like the paper for fuel, pollution is formed, and our air can become dirty. Our planet has an atmosphere to protect us from the sun (the tin foil), but unfortunately, it also traps all of the pollution and smog in the air in our environment, where it is harmful to the entire ecosystem.

Bonus activity: Have your students draw pictures of what they think a clean, healthy environment looks like (compared to the drawings of what they saw in the jar), and hang them up for everyone to see.

*adapted from Propane Education & Research Council (PERC)

Video from Forecast Earth

<http://www.airnow.gov/index.cfm?action=movies.index>

Click on Forecast Earth: Air Aware Video – 22 minutes long

Air Quality Resources

The Sinister Seven

Your students can learn about some of the major and most common air pollutants by putting on this play. By performing the play, they can teach each other about the pollution problems in our atmosphere, and how we can make our air cleaner.

Assign each part of the play under “Cast of Characters” and pass out copies of the play. Give students time to read over the play, and ask questions if necessary.

Lead In

We are going to put on a play helping us teach each other about the different types of air pollution.

Procedures

- Assign characters (there are 24 parts—enough for each student to have a character, if there is a smaller group then one student can play all the Toxins, or all the Particulates, etc).
- Have the class quietly read the play to familiarize themselves with their character
- Perform the play
- Conclude with a summary of the pollutants, and how we all can make our air cleaner

Cast of Characters: (for 24 students, but can be modified for a smaller group)

- Connie Lung—reporter from Smoky Mountain News
- Harry Wheezer—reporter from Smoky Mountain News
- The Particulates: (3 characters, or can be modified for a smaller group)
 - Grime
 - Soot
 - Dust
- Toxins: (5 characters, or can be modified for a smaller group)
 - Sulfur Dioxide
 - Nitrogen Oxides: (3 characters, or can be modified for a smaller group)
 - Bad Ozone
 - Good Ozone
 - Chlorofluorocarbons (CFCs): (3 characters, or can be modified for a smaller group)

Air Quality Resources

- EPA scientists: (2 characters, or can be modified for a smaller group)
- Carbon Dioxide: (2 characters, or can be modified for a smaller group)

How to Begin

Setting

The play begins in front of the Environmental Protection Agency (EPA) building. The air pollutants are picketing the EPA. Some carry picket signs (optional), or are yelling about how dirty air is the way to be. TV reporters Connie Lung and Harry Wheezer from Smoky Mountain News are at the center stage. In turn, each pollutant will come to the reporters to be interviewed, while the other pollutants will continue to protest in the background.

Script

Connie: Hi! I'm Connie Lung.

Harry: And I'm Harry Wheezer from Smoky Mountain News. We're here at the Environmental Protection Agency to cover a late-breaking story. Several of the world's worst pollutants are picketing the EPA to protest clean-air legislation.

Connie: In tonight's special report, we'll give you the scoop on where these pollutants come from and the ways they can hurt people and other living things.

Harry: Our first interview is with the Particulates. (The 3 Particulates walk over, chanting).

Particulates: (all together)
Dust, Soot and Grime
Pollution's not a crime
Soot, Grime and Dust,
The EPA's unjust!

Connie: (coughs) So apparently you're the Particulates.

Particulate (Soot): Yeah, I'm Soot, this is Grime and this is Dust.

Harry: So, you guys are those tiny bits of pollution that makes the air look really dirty and nasty?

Air Quality Resources

Particulate (Grime): Yeah! We get stirred up during construction, mining, and farming. (throw dirt up in the air)

Particulate (Soot): But most of the time we get into the air when stuff is burned—like gasoline in cars and trucks or coal in a power plant and even wood in a wood-burning stove!

Particulate (Grime): And we love to make Great Smoky Mountains National Park look hazy and smoky. On hot summer days, it used to be that you could see over a hundred miles, and there were mountains as far as you could see. Nowadays, because of us, there are some days that you can barely see 20 miles! (Gives Dust and Soot high five).

Harry: But wait! I thought these were called the Smokies because of the mist—and it looks like smoke in the air.

Particulate (Soot): That's what a lot of people think, but actually this National Park was called the Smokies cause of all the rain it gets, and all the fog that made the mountains look like smoke. But we're here now, and at the rate you humans are going, using so much gas and electricity, we aren't going anywhere!

Particulate (Dust): Yeah, and we just love to get into your eyes and make them itch and make your throat hurt and...

Particulate (Grime): (interrupts) Come on Dust, quit bragging! We gotta get back to the picket line. (Particulates return to the picket line.)

Connie: Let's introduce the folks at home to our next pollutant, some of the most dangerous air pollutants, The Toxins. (The Toxins walk over)

Harry: You Toxins are made up of all kinds of poisons. How did you get into the air?

Toxins 1: Hey, man, we come from everywhere you can think of... Chemical plants, dry cleaners, oil refineries, hazardous-waste sites, paint factories...

Toxins 2: Yeah, and cars and trucks dump a lot of us into the air too. You probably don't know it, but gasoline is loaded with us toxins.

Toxins 3: Wow, that's for sure! There's all kinds of nasty stuff in gasoline.

Air Quality Resources

Connie: Scientists say you cause cancer and other kinds of diseases. What do you think of that?

Toxins 4: They can't prove a thing!!!!

Toxins 5: That's why we're here—to make sure you people don't pass any more laws that might keep us out of the air. C'mon, Toxins—we're outta here! (Toxins return to the picket line. Sulphur Dioxide walks over).

Connie: Next we'd like you to meet Sulphur Dioxide. (Turns to face Sulphur Dioxide). I understand you just blew in from a power plant in Ohio.

Sulphur: Hey, I wouldn't miss this for all the pollution in Great Smoky Mountains National Park!

Harry: I'm sure the folks at home would like to know how you get into our air.

Sulphur: Well, heck, don't they read the newspapers? I've been making the front page at least once a week! Most of the time, I shoot out of smokestacks when power plants burn coal to make electricity.

Connie: And what kinds of nasty, disgusting things do you do?

Sulphur: Nasty, yup that's me! (hehehe) I think it's cool to make it hard for some people to breathe. And I can make trees and other plants grow more slowly. But here's the most rotten thing I do: When I get way up into the air, I mix with water in the sky, and presto! You get acid rain! (laughs evilly)

Harry: Acid rain is a huge problem in Great Smoky Mountains National Park! It can hurt or kill fish, salamanders, and other animals that live in our streams. Scientists also think that it makes trees and plants sick. Acid rain can even eat away at statues and buildings.

Sulphur: (proudly) That's right. Hey, I can even travel a long way to do my dirty work. If I get pumped out of a smokestack in Ohio, I can ride the wind for hundreds of miles and turn up as acid rain in the Smokies.

Connie: I sure hope we can get rid of you soon, Sulphur Dioxide!

Sulphur: Good Luck, you guys! I gotta do some more picketing before I catch the next wind! (Sulphur Dioxide returns to the picket line, and the

Air Quality Resources

Nitros walk over)

Harry: He's rotten!

Nitros (all together): You think Sulphur Dioxide is rotten, well you haven't met us!

Connie: You must be the Nitrogen Oxides

Nitro 1: Just call us the Nitros for short. (Turns to the other characters)
Give me an "N"!

Everyone: "N"!

Nitro 2: Give me an "I"!

Everyone: "I"!

Nitro 3: Give me a "T"!

Everyone: "T"!

Nitro 1: Give me a "R"!

Everyone: "R"!

Nitro 2: Give me an "O"!

Everyone: "O"!

Nitro 3: What's that spell?

Everyone: Nitro!

Nitro 1: What's that mean?

Nitro 2 and 3: Dirty air!!!

Harry: Hey I didn't know that pollutants could spell.

Nitro 3: Very funny, Harry.

Connie: So, how did you Nitrogen Oxides get into the air?

Nitro 1: We get airborne when cars, planes, trucks and power plants

Air Quality Resources

burn fuels.

Harry: And what happens when you are in the air?

Nitro 2: We can make people's lungs hurt when they breathe—especially people who already have asthma. Plus we can mix with moisture in the air and make acid rain!

Nitro 3: But we also make another form of pollution. And here it is... BAD OZONE! (Bad ozone waves and walks towards the reporters while the Nitros head back to the picket line).

Bad Ozone: Well, my friends, the Nitros pour into the air and they get together with some other pollutants. As the sun shines on all these lovely pollutants, it heats them up—and creates me! Bad Ozone, and where's there's bad ozone, there's smog.

Harry: Smog is made up mostly of ozone and particulate matter.

Connie: That's right, Harry. And smog can really make city life miserable. It can make your eyes burn, your head ache and it can damage your lungs.

Harry: But what I want to know is, if ozone is so bad, why are people worried about holes in the ozone layer? (Good Ozone walks onstage)

Good Ozone: That low-level ozone is my rotten twin sister—she's just a good gas turned bad! I'm the good ozone that forms a layer high above the Earth. I help absorb the harmful rays of the sun.

Bad Ozone: (nastily to Good Ozone) So, why on Earth are you here, sis?

Good Ozone: I'm here to support the clean air laws. If certain chemicals keep getting pumped into the atmosphere, I'll disappear. And without me, the harmful rays of the sun will kill some kinds of plants and give many more people skin cancer and eye diseases!

Harry: But what kinds of chemicals are making you disappear?

Good Ozone: It's those terrible CFCs! (CFCs walk over from the picket line)

CFC 1: Hey, we're not so bad! People have used us CFCs in coolants for refrigerators and air conditioners for your home and car.

Air Quality Resources

Connie: Wait a minute, I thought that CFCs were outlawed in the United States in 1978 because they harm the ozone layer.

CFC 2: So what if we destroyed a little bit of the ozone layer? There's enough to last for years!

CFC 3: Yeah—who needs the ozone layer anyway?

Good Ozone: People do! Tell them what else you CFCs are doing!!!

CFC 1: What's Ozone complaining about now, let me guess...global warming? (EPA scientist walk onstage)

Scientist 1: Excuse me, but did I just hear someone mention global warming?

CFC 1: Oh no. What do you want?

Scientist 2: We just happen to be experts on global climate change.

Scientist 1: Well, over the past 100 years or so, people have poured huge amounts of gasses, such as CFCs and carbon dioxide into the air.

Scientist 2: And as they build up in the atmosphere, these gases may be acting like the glass in a greenhouse.

Scientist 1: That's right. They let the radiation from the sun in, but they keep the heat from getting out. And this is causing Earth's climate to become warmer.

Harry: I've read that if the temperature goes up, the polar ice caps will melt, and the sea levels may rise. Wow, some cities on the coast might be under water some day!

Scientist 1: It's certainly possible.

Scientist 2: Well, nice talking with you, but we've got to do some more research on our changing climate. (Pollutants yell at scientists, give them dirty looks as they walk off stage).

CFC 3: Hey, we're not even the biggest cause of global climate change. You gotta talk to another of the big pollutants about that.

Harry: There's only one other pollutant on the list: Carbon Dioxide!

Air Quality Resources

(Carbon Dioxide 1 and 2 walk over)

Carbon Dioxide 1: Did we hear you mention our name? We didn't used to be thought of as a bad gas. About a hundred years ago, there was just the right amount of us in the air.

Carbon Dioxide 2: But then people started burning things—they built power plants that burn coal, and cars and trucks that burn gasoline. And they started cutting down trees and burning forests! Every bit of that burning releases us into the air.

Carbon Dioxide 1: As more and more of us got into the air, people started saying that the Earth was warming up—because of us!

Carbon Dioxide 2: Yeah—like it's our fault! The reason you're in such a mess is because you use so much fuel and cut down so many trees!

Connie: You're right, Carbon Dioxide. Maybe we should be doing a special report on people—we're the ones who are really causing air pollution.

Harry: But people can change! We can limit how much pollution we make. Can't we think of some ways that people can help fight air pollution? We outlawed using CFCs that depleted the ozone layer, so I am sure that we can do more to improve our air quality.

Connie: And that's the end of our special report. The bottom line? These air pollutants are a pretty tough bunch—but people create them, and people can reduce the amounts that are in our atmosphere. Thank you, and from everyone at Smoky Mountain News—good night.

The End!

This play was adapted from the Texas Commission on Environmental Quality Lesson Plans for Teachers and was submitted to them by Lois Meyers, Stephen F. from Austin State University, TES 1994.

Air Quality Resources

What is Air Pollution and Where Does It Come From?

- VOCs (VOLATILE ORGANIC COMPOUNDS)



- NOx (NITROGEN OXIDES)



Air Quality Resources

What is Air Pollution and Where Does It Come From?

- NOx (NITROGEN OXIDES)



- PARTICULATE MATTER (PM)

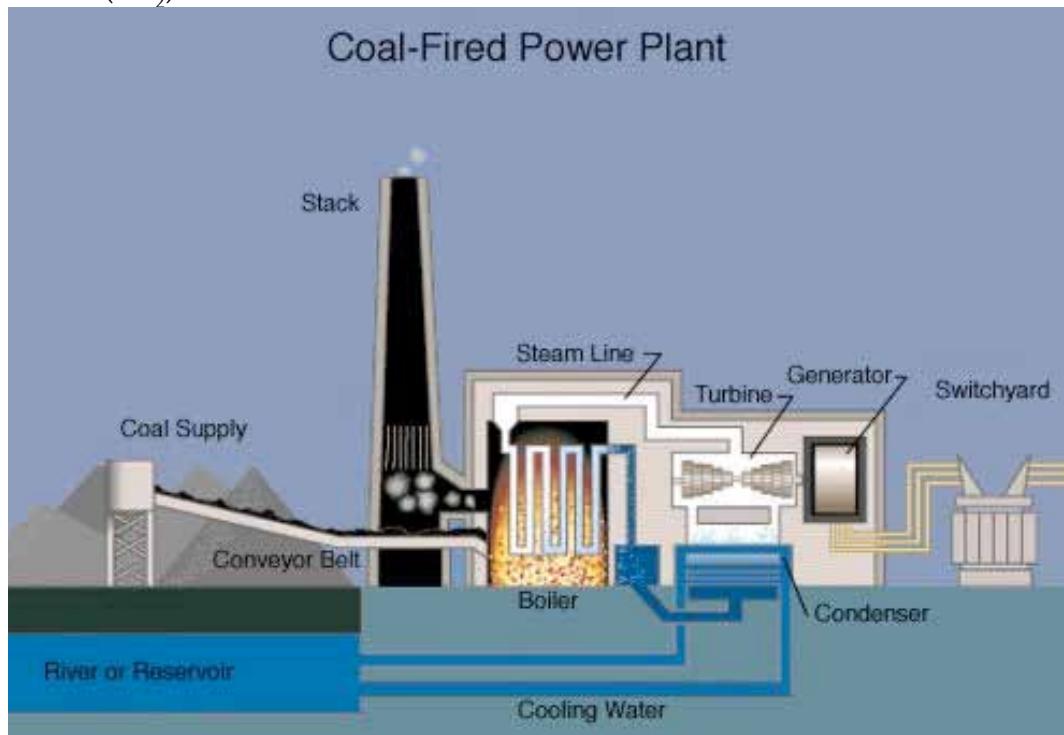


Picture Copyright © 1998-2001 Carver County
<http://www.co.carver.mn.us/EnviroServices/burnbarrel.htm>

Air Quality Resources

What is Air Pollution and Where Does It Come From?

- SULFUR DIOXIDE (SO_2)



- SULFUR DIOXIDE (SO_2)



Air Quality Resources

What is Air Pollution and Where Does It Come From?

- O₃ OR BAD OZONE

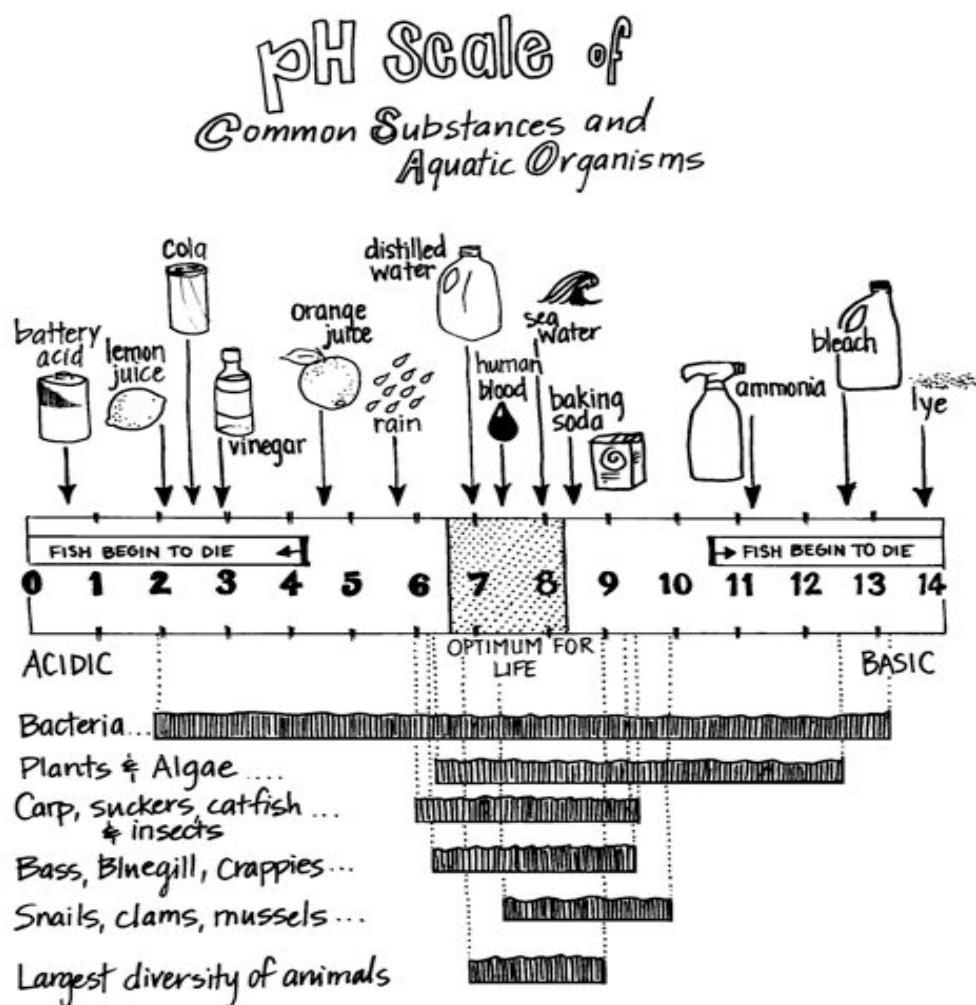


- PARTICULATE POLLUTION (HAZE)



Air Quality Resources

pH Scale Sheet (What's the Big Deal with Acids and Bases?)



Air Quality Resources

Coal Power Plant Pictures (How is This Affecting the Smokies -There Aren't Any Smokestacks?)



Air Quality Resources

City Cards (How is This Affecting the Smokies -There Aren't Any Smokestacks?)

ATLANTA

BIRMINGHAM

CHICAGO

CINCINNATI

CLEVELAND

INDIANAPOLIS

JACKSON

MEMPHIS

NASHVILLE

NEW ORLEANS

NEW YORK

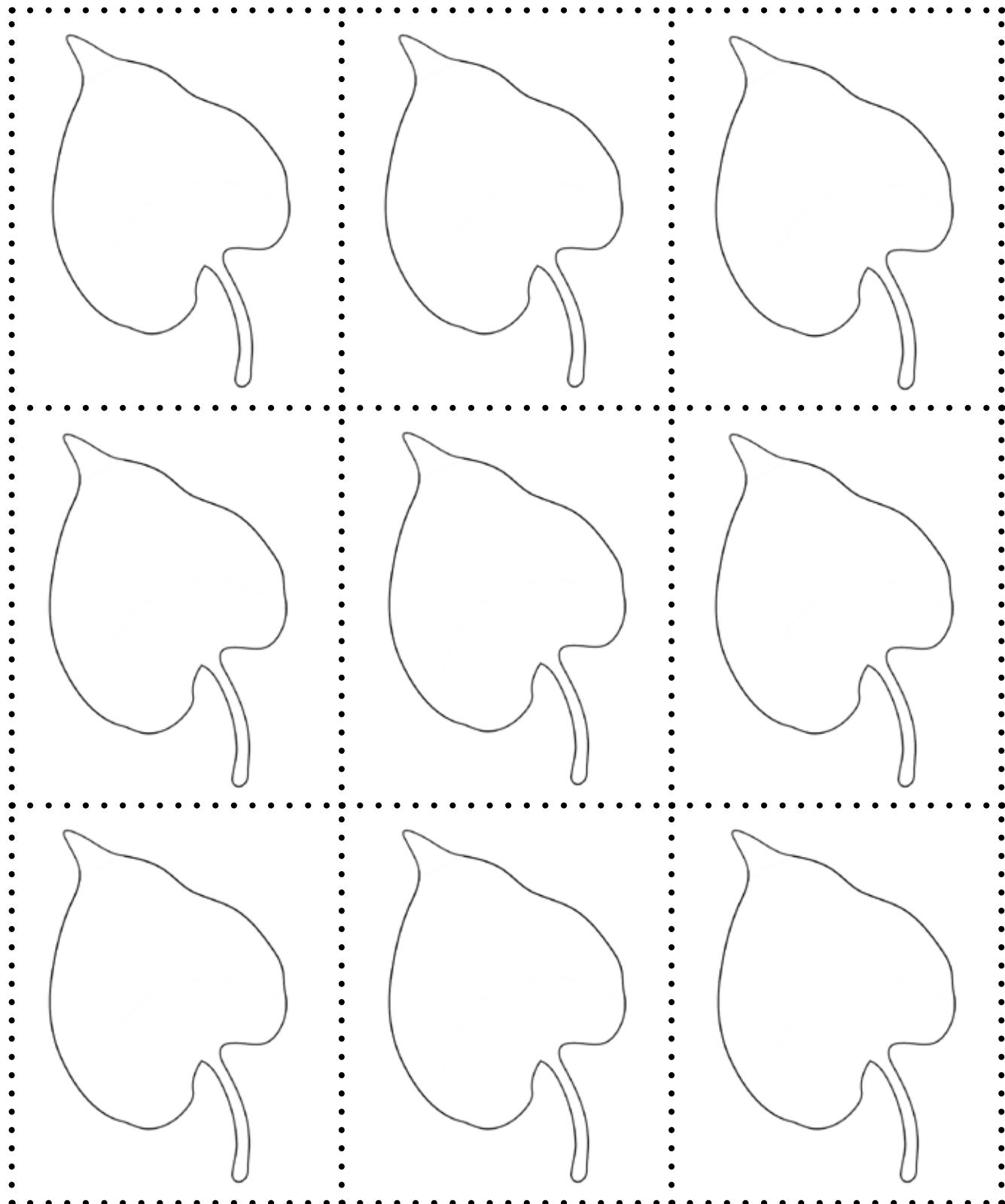
RALEIGH

SAINT LOUIS

WASHINGTON, DC

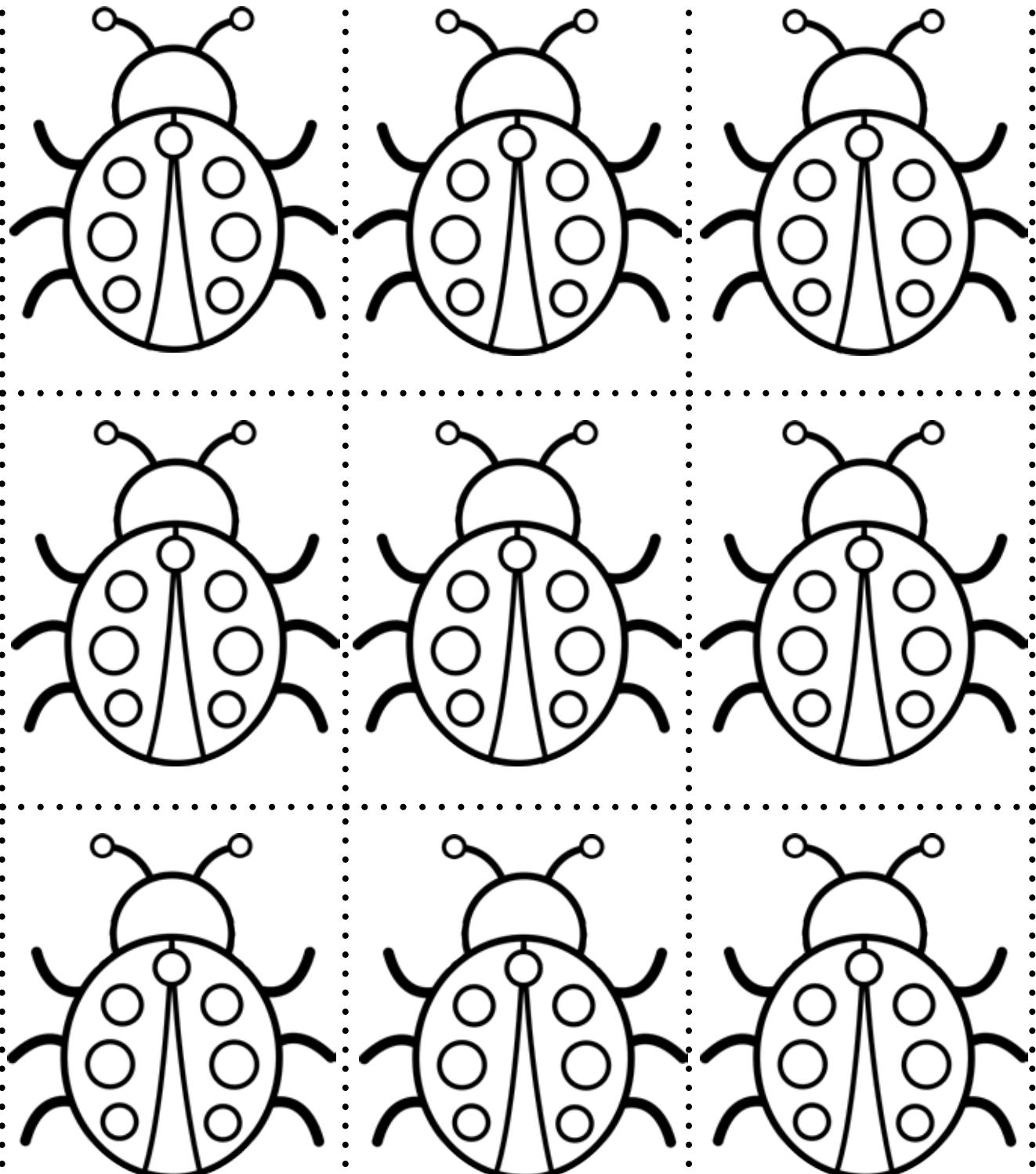
Air Quality Resources

Leaf Shapes (Keep the Calcium)



Air Quality Resources

Ladybug Shapes (Keep the Calcium)

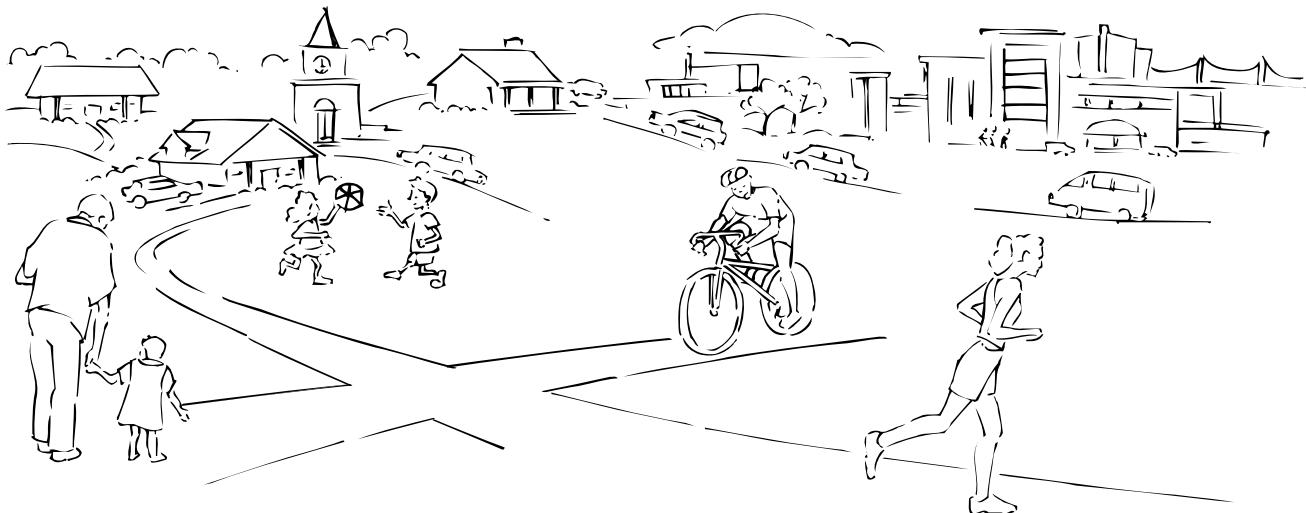


Air Quality Resources

Air Quality and Human Health



ASTHMA AND OUTDOOR AIR POLLUTION



1 Air pollution can make asthma symptoms worse and trigger attacks.

If you or your child has asthma, have you ever noticed symptoms get worse when the air is polluted? Air pollution can make it harder to breathe. It can also cause other symptoms, like coughing, wheezing, chest discomfort, and a burning feeling in the lungs.

Two key air pollutants can affect asthma. One is *ozone* (found in smog). The other is *particle pollution* (found in haze, smoke, and dust). When ozone and particle pollution are in the air, adults and children with asthma are more likely to have symptoms.

2 You can take steps to help protect your health from air pollution.

► Get to know how sensitive you are to air pollution.

- Notice your asthma symptoms when you are physically active. Do they happen more often when the air is more polluted? If so, you may be sensitive to air pollution.

- Also notice any asthma symptoms that begin up to a day *after* you have been outdoors in polluted air. Air pollution can make you more sensitive to asthma triggers, like mold and dust mites. If you are more sensitive than usual to indoor asthma triggers, it could be due to air pollution outdoors.

► Know when and where air pollution may be bad.

- *Ozone* is often worst on hot summer days, especially in the afternoons and early evenings.
- *Particle pollution* can be bad any time of year, even in winter. It can be especially bad when the weather is calm, allowing air pollution to build up. Particle levels can also be high:
 - Near busy roads, during rush hour, and around factories.
 - When there is smoke in the air from wood stoves, fireplaces, or burning vegetation.

Air Quality Resources

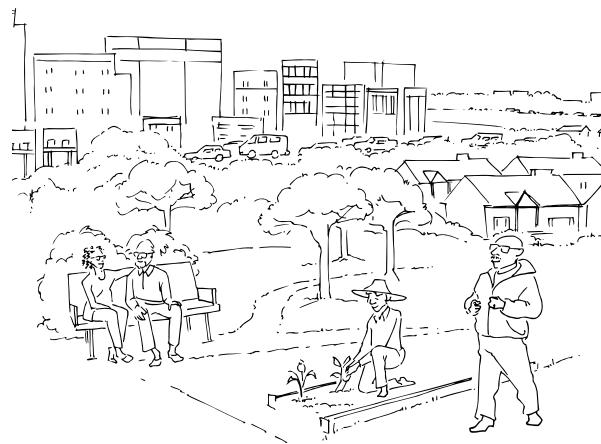


Heart Disease, Stroke, and Outdoor Air Pollution

1 Did you know that air pollution can trigger heart attacks, stroke, and other health effects?

Medical studies show that air pollution can trigger heart attacks, stroke, and irregular heart rhythms—especially in people who are already at risk for these conditions. Also, for people with a medical condition called heart failure, air pollution can further reduce the ability of the heart to pump blood the way that it should. Very small particles are the pollutants of greatest concern for triggering these effects. Particle pollution is found in haze, smoke, and dust—and sometimes in air that looks clean. This fact sheet tells you how you can:

- Get up-to-date information about your local air quality.
- Protect your health when particle pollution is at unhealthy levels.



2 Are you at higher risk?

For most people, the risk is small. Older adults and people with risk factors for heart disease or stroke may be at greater risk. You are at greater risk if you:

- Have had a heart attack, angina, bypass surgery, angioplasty with or without a stent, a stroke, blockages in the neck or leg arteries, heart failure, heart rhythm problems, diabetes, or chronic obstructive lung disease.

You may be at greater risk of heart disease or stroke (and therefore at greater risk from particle pollution) if any of these apply:

- You are a man 45 years or older, or a woman 55 years or older.
- You have a family history of stroke or early heart disease (father or brother diagnosed before age 55; mother or sister diagnosed before age 65).
- You have high blood pressure or high blood cholesterol.
- You are overweight or not physically active.
- You smoke cigarettes.

3 How can you protect your health?

Regular exercise is important for staying healthy, especially if you have heart disease. By adjusting when and where you exercise, you can lead a healthier lifestyle and help reduce your risk of heart problems or stroke triggered by air pollution. In addition:

- If you have heart disease or have experienced a stroke, check with your health care provider about the best ways to protect your health when the air quality is unhealthy.
- If you're at risk of heart disease or stroke and plan to exercise more than usual, discuss this with your health care provider.

► Know when and where particle pollution levels may be unhealthy.

Particle pollution levels can be high any time of year. Levels can be especially high when the weather is calm, allowing air pollution to build up. Particle levels can also be high:

- Near busy roads, in urban areas (especially during rush hour), and in industrial areas.
- When there is smoke in the air from wood stoves, fireplaces, burning vegetation, or forest fires.

Air Quality Resources



Air Quality Guide for Ozone

Air Quality Index	Protect Your Health
Good (0-50)	No health impacts are expected when air quality is in this range.
Moderate (51-100)	Unusually sensitive people should consider limiting prolonged outdoor exertion.
Unhealthy for Sensitive Groups (101-150)	The following groups should limit prolonged outdoor exertion: <ul style="list-style-type: none">• People with lung disease, such as asthma• Children and older adults• People who are active outdoors
Unhealthy (151-200)	The following groups should avoid prolonged outdoor exertion: <ul style="list-style-type: none">• People with lung disease, such as asthma• Children and older adults• People who are active outdoors Everyone else should limit prolonged outdoor exertion.
Very Unhealthy (201-300)	The following groups should avoid all outdoor exertion: <ul style="list-style-type: none">• People with lung disease, such as asthma• Children and older adults• People who are active outdoors Everyone else should limit outdoor exertion.

What You Should Know About Ozone and Your Health

- Ozone in the air we breathe can harm our health—particularly on hot, sunny days when ozone can reach unhealthy levels.
- Even relatively low levels of ozone can cause health effects.
- People with lung disease, children, older adults, and people who are active outdoors may be particularly sensitive to ozone.
- Ozone exposure may also increase the risk of premature death from heart or lung disease.
- This fact sheet tells you how you can find out when air quality is unhealthy and take simple steps to protect your health.

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Green Team)

Team Green

1. Which of the following activities can help reduce the amounts of dangerous substances in the air?
 - a) greater use of public transportation (go to the Council House)
 - b) greater use of private cars (go to the Recycling Shed)
 - c) use of leaded gasoline (go to the rear Dorm door, on the boys' side)

2. Which is probably not a health effect of ozone?
 - a) obesity (go to the door outside the Cove Room)
 - b) coughing during exercise (go to the bench near the basketball hoop)
 - c) lung inflammation (go to the Nature Trail Benches)

3. Which of the following can help improve air quality?
 - a) a gas station (go to the Pavilion)
 - b) an airplane (go to the brown door near the corner of the Office)
 - c) walking (go to the Recycling Shed)

4. Air pollution can harm the health of which of the following?
 - a) humans (go to the Friendship Circle)
 - b) animals (go to the rear Dorm door, on the boys' side)
 - c) plants (go to the Council House)
 - d) all of the above (go to the Nature Trail Benches)

5. Everyone is affected by the quality of our air. Which people in particular are likely to become sick from air pollution?
 - a) tall people (go to the door outside the Cove Room)
 - b) people with pre-existing heart or lung conditions (go to the Friendship Circle)
 - c) people who work indoors (go to the River House)

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Green Team) Page 2

6. In what ways can you conserve energy?
 - a) leave lights on (go to the brown door near the corner of the Office)
 - b) use cold water instead of hot (go to the Pavilion)
 - c) drive your car instead of a bus (go to the bench near the basketball hoop)
7. Which of the following can help to spread polluted air?
 - a) fossil fuels (go to the Nature Trail Benches)
 - b) traffic lights (go to the brown door near the corner of the Office)
 - c) wind (go to the rear Dorm door, on the boys' side)
8. Using your fireplace less, not burning trash and preventing forest fires prevents what kind of air pollution?
 - a) ozone (go to the Friendship Circle)
 - b) particulate matter (go to the brown door near the corner of the Office)
 - c) acid rain (go to the Council House)
9. Which of the following ways will not help conserve energy?
 - a) using reusable plastic water bottles (go to the Recycling Shed)
 - b) using cloth bags instead of plastic at the grocery store (go to the River House)
 - c) buying products with lots of packaging (go to the bench near the basketball hoop)
10. Great Smoky Mountains National Park is polluted because:
 - a) of natural causes (go to the door outside the Cove Room)
 - b) the park has power plants that create pollution (go to the Pavilion)
 - c) winds blow in pollution from the West that builds up in the mountains (go to the River House)

When you're done, please return to your Teacher/Naturalist!

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Blue Team)

Team Blue

1. Which of the following can help improve air quality?
 - a) a gas station (go to the bench near the basketball hoop)
 - b) an airplane (go to the Recycling Shed)
 - c) walking (go to the bench near the basketball hoop)
2. Great Smoky Mountains National Park is polluted because:
 - a) of natural causes (go to the River House)
 - b) the park has power plants that create pollution (go to the rear Dorm door, on the boys' side)
 - c) winds blow in pollution from the West that builds up in the mountains (go to the River House)
3. Everyone is affected by the quality of our air. Which people in particular are likely to become sick from air pollution?
 - a) tall people (go to the bench near the basketball hoop)
 - b) people with pre-existing heart or lung conditions (go to the Council House)
 - c) people who work indoors (go to the Nature Trail Benches)
4. In what ways can you conserve energy?
 - a) leave lights on (go to the River House)
 - b) use cold water instead of hot (go to the door outside the Cove Room)
 - c) drive your car instead of a bus (go to the Friendship Circle)
5. Which of the following can help to spread polluted air?
 - a) fossil fuels (go to the Nature Trail Benches)
 - b) traffic lights (go to the Pavilion)
 - c) wind (go to the Recycling Shed)

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Blue Team) Page 2

6. Which of the following activities can help reduce the amounts of dangerous substances in the air?
 - a) greater use of public transportation (go to the Nature Trail Benches)
 - b) greater use of private cars (go to the rear Dorm door, on the boys' side)
 - c) use of leaded gasoline (go to the Friendship Circle)

7. Using your fireplace less, not burning trash and preventing forest fires prevents what kind of air pollution?
 - a) ozone (go to the River House)
 - b) particulate matter (go to the Friendship Circle)
 - c) acid rain (go to the brown door near the corner of the Office)

8. Air pollution can harm the health of which of the following?
 - a) humans (go to the River House)
 - b) animals (go to the bench near the basketball hoop)
 - c) plants (go to the brown door near the corner of the Office)
 - d) all of the above (go to the Pavilion)

9. Which is probably not a health effect of ozone?
 - a) obesity (go to the rear Dorm door, on the boys' side)
 - b) coughing during exercise (go to the Recycling Shed)
 - c) lung inflammation (go to the bench near the basketball hoop)

10. Which of the following ways will not help conserve energy?
 - a) using reusable plastic water bottles (go to the River House)
 - b) using cloth bags instead of plastic at the grocery store (go to the Pavilion)
 - c) buying products with lots of packaging (go to the brown door near the corner of the Office)

When you're done, please return to your Teacher/Naturalist!

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Red Team)

Team Red

1. Great Smoky Mountains National Park is polluted because:
 - a) of natural causes (go to the Council House)
 - b) the park has power plants that create pollution (go to the Recycling Shed)
 - c) winds blow in pollution from the West that builds up in the mountains (go to the rear Dorm door, on the boys' side)
2. Air pollution can harm the health of which of the following?
 - a) humans (go to the River House)
 - b) animals (go to the door outside the Cove Room)
 - c) plants (go to the Pavilion)
 - d) all of the above (go to the brown door near the corner of the Office)
3. Which of the following can help improve air quality?
 - a) a gas station (go to the rear Dorm door, on the boys' side)
 - b) an airplane (go to the Friendship Circle)
 - c) walking (go to the bench near the basketball hoop)
4. Which of the following can help to spread polluted air?
 - a) fossil fuels (go to the door outside the Cove Room)
 - b) traffic lights (go to the Recycling Shed)
 - c) wind (go to the River House)
5. Which is probably not a health effect of ozone?
 - a) obesity (go to the Council House)
 - b) coughing during exercise (go to the bench near the basketball hoop)
 - c) lung inflammation (go to the brown door near the corner of the Office)

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Red Team) Page 2

6. In what ways can you conserve energy?

- a) leave lights on (go to the rear Dorm door, on the boys' side)
- b) use cold water instead of hot (go to the door outside the Cove Room)
- c) drive your car instead of a bus (go to the Friendship Circle)

7. Using your fireplace less, not burning trash and preventing forest fires prevents what kind of air pollution?

- a) ozone (go to the Nature Trail Benches)
- b) particulate matter (go to the Recycling Shed)
- c) acid rain (go to the bench near the basketball hoop)

8. Everyone is affected by the quality of our air. Which people in particular are likely to become sick from air pollution?

- a) tall people (go to the brown door near the corner of the Office)
- b) people with pre-existing heart or lung conditions (go to the Nature Trail Benches)
- c) people who work indoors (go to the door outside the Cove Room)

9. Which of the following ways will not help conserve energy?

- a) using reusable plastic water bottles (go to the River House)
- b) using cloth bags instead of plastic at the grocery store (go to the Pavilion)
- c) buying products with lots of packaging (go to the Friendship Circle)

10. Which of the following activities can help reduce the amounts of dangerous substances in the air?

- a) greater use of public transportation (go to the Pavilion)
- b) greater use of private cars (go to the Nature Trail Benches)
- c) use of leaded gasoline (go to the Council House)

When you're done, please return to your Teacher/Naturalist!

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Purple Team)

Team Purple

1. Everyone is affected by the quality of our air. Which people in particular are likely to become sick from air pollution?
 - a) tall people (go to the rear Dorm door, on the boys' side)
 - b) people with pre-existing heart or lung conditions (go to the Friendship Circle)
 - c) people who work indoors (go to the River House)
2. Which is probably not a health effect of ozone?
 - a) obesity (go to the Pavilion)
 - b) coughing during exercise (go to the bench near the basketball hoop)
 - c) lung inflammation (go to the door outside the Cove Room)
3. Great Smoky Mountains National Park is polluted because:
 - a) of natural causes (go to the brown door near the corner of the Office)
 - b) the park has power plants that create pollution (go to the Council House)
 - c) winds blow in pollution from the West that builds up in the mountains (go to the rear Dorm door, on the boys' side)
4. Which of the following ways will not help conserve energy?
 - a) using reusable plastic water bottles (go to the Friendship Circle)
 - b) using cloth bags instead of plastic at the grocery store (go to the Recycling Shed)
 - c) buying products with lots of packaging (go to the brown door near the corner of the Office)
5. Which of the following can help to spread polluted air?
 - a) fossil fuels (go to the Pavilion)
 - b) traffic lights (go to the Nature Trail Benches)
 - c) wind (go to the bench near the basketball hoop)

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Purple Team) Page 2

6. Using your fireplace less, not burning trash and preventing forest fires prevents what kind of air pollution?
 - a) ozone (go to the Council House)
 - b) particulate matter (go to the River House)
 - c) acid rain (go to the door outside the Cove Room)
7. In what ways can you conserve energy?
 - a) leave lights on (go to the Recycling Shed)
 - b) use cold water instead of hot (go to the Council House)
 - c) drive your car instead of a bus (go to the River House)
8. Which of the following can help improve air quality?
 - a) a gas station (go to the bench near the basketball hoop)
 - b) an airplane (go to the Friendship Circle)
 - c) walking (go to the door outside the Cove Room)
9. Which of the following activities can help reduce the amounts of dangerous substances in the air?
 - a) greater use of public transportation (go to the Recycling Shed)
 - b) greater use of private cars (go to the Nature Trail Benches)
 - c) use of leaded gasoline (go to the Pavilion)
10. Air pollution can harm the health of which of the following?
 - a) humans (go to the rear Dorm door, on the boys' side)
 - b) animals (go to the Friendship Circle)
 - c) plants (go to the brown door near the corner of the Office)
 - d) all of the above (go to the Nature Trail Benches)

When you're done, please return to your Teacher/Naturalist!

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Black Team)

Team Black

1. Everyone is affected by the quality of our air. Which people in particular are likely to become sick from air pollution?
 - a) tall people (go to the Friendship Circle)
 - b) people with pre-existing heart or lung conditions (go to the Recycling Shed)
 - c) people who work indoors (go to the brown door near the corner of the Office)

2. Which is probably not a health effect of ozone?
 - a) obesity (go to the Nature Trail Benches)
 - b) coughing during exercise (go to the bench near the basketball hoop)
 - c) lung inflammation (go to the Pavilion)

3. Great Smoky Mountains National Park is polluted because:
 - a) of natural causes (go to the rear Dorm door, on the boys' side)
 - b) the park has power plants that create pollution (go to the River House)
 - c) winds blow in pollution from the West that builds up in the mountains (go to the Friendship Circle)

4. Which of the following ways will not help conserve energy?
 - a) using reusable plastic water bottles (go to the Recycling Shed)
 - b) using cloth bags instead of plastic at the grocery store (go to the door outside the Cove Room)
 - c) buying products with lots of packaging (go to the Pavilion)

5. Which of the following can help to spread polluted air?
 - a) fossil fuels (go to the Nature Trail Benches)
 - b) traffic lights (go to the Council House)
 - c) wind (go to the rear Dorm door, on the boys' side)

Air Quality Resources

Air Quality Scavenger Hunt Question Sheet (Black Team) Page 2

6. Using your fireplace less, not burning trash and preventing forest fires prevents what kind of air pollution?
 - a) ozone (go to the bench near the basketball hoop)
 - b) particulate matter (go to the brown door near the corner of the Office)
 - c) acid rain (go to the Recycling Shed)
7. In what ways can you conserve energy?
 - a) leave lights on (go to the River House)
 - b) use cold water instead of hot (go to the bench near the basketball hoop)
 - c) drive your car instead of a bus (go to the Pavilion)
8. Which of the following can help improve air quality?
 - a) a gas station (go to the Council House)
 - b) an airplane (go to the door outside the Cove Room)
 - c) walking (go to the River House)
9. Which of the following activities can help reduce the amounts of dangerous substances in the air?
 - a) greater use of public transportation (go to the Council House)
 - b) greater use of private cars (go to the Friendship Circle)
 - c) use of leaded gasoline (go to the Recycling Shed)
10. Air pollution can harm the health of which of the following?
 - a) humans (go to the Nature Trail Benches)
 - b) animals (go to the rear Dorm door, on the boys' side)
 - c) plants (go to the brown door near the corner of the Office)
 - d) all of the above (go to the door outside the Cove Room)

When you're done, please return to your Teacher/Naturalist!

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Bench Near Basketball Court)

	Green	Blue	Red	Purple	Black
#1)	D	T	F	H	U
#2)	F	X	E	F	Y
#3)	H	S	L	R	T
#4)	Q	D	B	Q	R
#5)	R	C	R	O	E
#6)	T	V	G	Q	W
#7)	U	F	N	J	N
#8)	B	G	T	N	D
#9)	O	B	H	C	C
#10)	N	N	M	S	F

Bench near Basketball Hoop

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Council House)

	Green	Blue	Red	Purple	Black
#1)	L	W	E	P	P
#2)	R	E	D	O	Y
#3)	H	L	F	L	U
#4)	K	R	R	K	B
#5)	Q	T	W	I	V
#6)	Z	Y	G	J	D
#7)	L	H	T	A	G
#8)	W	J	Y	Y	H
#9)	E	K	H	G	R
#10)	I	T	J	T	M

Council House

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Cove Room)

	Green	Blue	Red	Purple	Black
#1)	H	C	I	C	Q
#2)	U	V	K	F	A
#3)	B	D	J	T	S
#4)	M	Y	U	V	D
#5)	X	F	Y	G	C
#6)	I	E	P	T	V
#7)	O	R	H	B	B
#8)	W	J	G	W	H
#9)	F	K	T	Y	Y
#10)	Z	O	R	N	E

Cove Room Door

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Friendship Circle)

	Green	Blue	Red	Purple	Black
#1)	V	R	P	E	U
#2)	C	T	O	A	J
#3)	D	Y	I	F	W
#4)	E	U	U	B	N
#5)	F	I	Y	Y	G
#6)	J	O	T	U	T
#7)	Y	A	R	N	V
#8)	T	P	L	N	B
#9)	B	G	E	U	D
#10)	V	H	J	Y	F

Friendship Circle

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Nature Trail Benches)

	Green	Blue	Red	Purple	Black
#1)	F	Z	F	P	A
#2)	U	X	V	O	Y
#3)	T	C	G	I	X
#4)	E	V	B	U	C
#5)	K	B	H	Y	V
#6)	L	H	N	T	B
#7)	I	N	J	R	H
#8)	Q	M	A	E	N
#9)	X	R	N	W	J
#10)	R	T	M	S	M

Nature Trail Benches

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Office Door)

	Green	Blue	Red	Purple	Black
#1)	W	E	Q	D	A
#2)	E	D	T	E	W
#3)	R	R	P	S	S
#4)	T	F	W	P	D
#5)	H	T	O	H	E
#6)	K	G	C	H	G
#7)	O	Y	V	R	L
#8)	S	H	B	W	K
#9)	P	U	K	E	J
#10)	C	A	L	T	I

Office Door

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Pavilion)

	Green	Blue	Red	Purple	Black
#1)	R	S	X	Y	X
#2)	E	D	Q	R	C
#3)	U	F	E	U	V
#4)	J	G	V	J	N
#5)	A	J	T	K	F
#6)	S	K	B	N	G
#7)	R	I	Y	D	H
#8)	G	R	N	V	Y
#9)	U	N	U	S	T
#10)	Q	B	O	H	R

Pavilion

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Rear Dorm Door--Boys' Side)

	Green	Blue	Red	Purple	Black
#1)	T	C	R	B	D
#2)	R	F	S	V	C
#3)	H	V	D	R	F
#4)	J	G	F	S	V
#5)	K	B	C	D	I
#6)	U	H	V	G	G
#7)	I	N	G	Y	B
#8)	P	J	B	J	H
#9)	W	I	H	B	R
#10)	D	M	N	K	E

Rear Dorm Door – Boys' Side

Air Quality Resources

Air Quality Scavenger Hunt Location Card (Recycling Shed)

	Green	Blue	Red	Purple	Black
#1)	R	A	Q	A	E
#2)	I	S	A	S	I
#3)	F	D	W	D	J
#4)	L	W	S	F	G
#5)	N	H	E	G	G
#6)	O	R	D	H	Y
#7)	A	X	N	J	D
#8)	E	C	R	K	V
#9)	T	V	F	O	M
#10)	K	B	T	L	B

Recycling Shed

Air Quality Resources

Air Quality Scavenger Hunt Location Card (River House)

	Green	Blue	Red	Purple	Black
#1)	Q	R	Q	Y	W
#2)	W	E	A	U	E
#3)	E	F	X	J	R
#4)	S	T	P	D	F
#5)	D	G	E	F	G
#6)	F	Y	F	L	T
#7)	C	H	V	T	H
#8)	V	U	T	R	D
#9)	B	J	G	Q	Y
#10)	L	I	J	N	J

River House

Air Quality Resources

Air Quality Scavenger Hunt Answer Sheet

#1 #2 #3 #4 #5 #6 #7 #8 #9 #10

Team Green: L U F E F S I S O L
=Fossil fuel

Team Blue: T E L Y H H A R I A
=Healthy air

Team Red: R T L P W P N A E O
=Power plant

Team Purple: E R R P O L A W O S
=Solar power

Team Black: E Y W N I G N D R E
=Wind energy