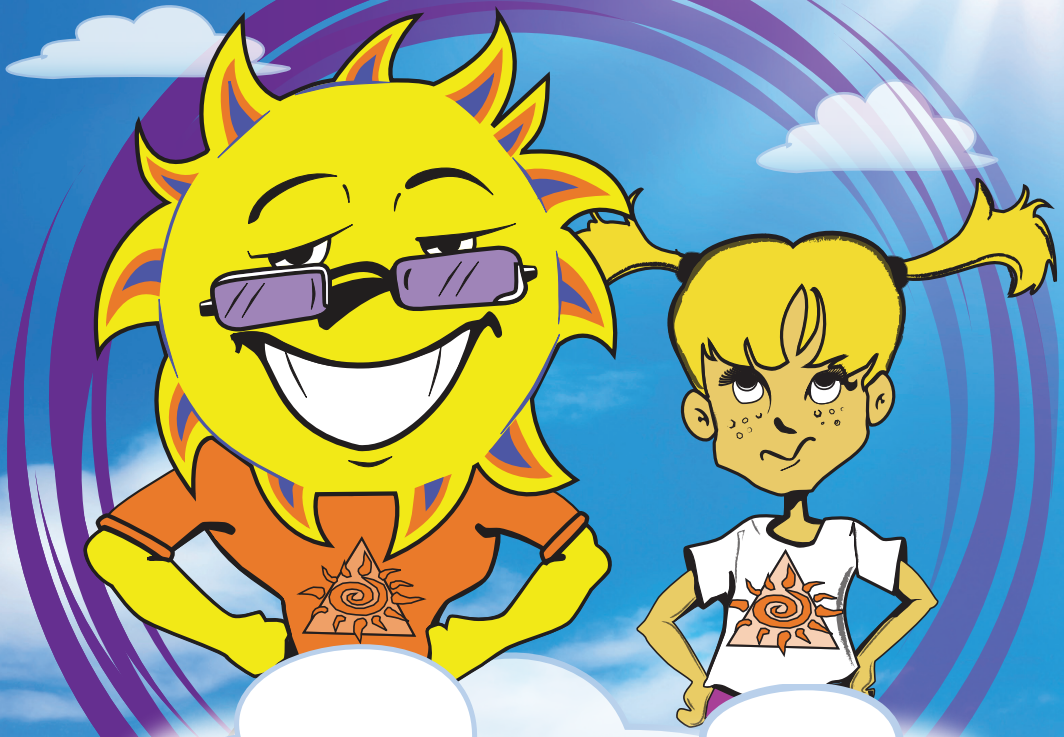
THE ADVENTURES OF CLAIR & CAM



K-5 Curriculum & Activity Guide

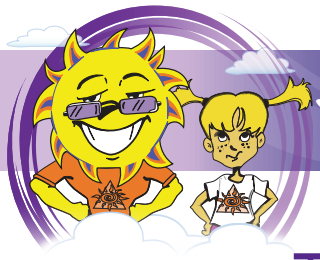
Air Quality Education

Videos, Lessons, Activities, and Music

A product of NC Air Awareness

Air Quality
ENVIRONMENTAL QUALITY

www.NCAIR.org



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MISSION

NC Division of Air Quality Mission

The Division of Air Quality (DAQ) works with the state's citizens to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit and economic well-being of all. To carry out this mission, the DAQ has programs to operate a statewide air quality monitoring network to measure the level of pollutants in the outdoor air, develop and implement plans to meet future air quality initiatives, assure compliance with air quality rules and educate, inform and assist the public with regard to air quality issues.

NC Air Awareness

NC Air Awareness is a DAQ public outreach and education program which reaches thousands of citizens annually, since 1997. Local Air Awareness Coordinators strategically located in six large metropolitan areas, including the Triangle region, provide outreach and education to students and the general public and work with businesses and organizations to teach them about ways to reduce their contribution to air pollution and protect their health.

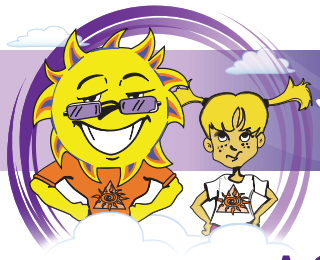
Triangle Air Awareness

The Triangle Air Awareness Program began as a public-private partnership between the DAQ and the Research Triangle Regional Partnership Foundation non-profit. The program enables students, teachers, individuals and businesses to quickly access information about air quality in the Triangle region. The goal is to help everyone learn how to be informed, take action and help reduce air pollution to keep our air clean and healthy for everyone.

Partnerships

This curriculum and activity guide was the result of a collaborative effort between the NC Air Awareness program team and the Triangle Air Awareness Program. Since the project spanned several years, multiple project and program directors were involved. Many thanks to everyone who helped complete this project!

NC
Air Quality
ENVIRONMENTAL QUALITY



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North Carolina Division of Air Quality (DAQ) supports this effort as part of its education and outreach program NC Air Awareness.

INTRODUCTION

HOW CLEAN IS OUR AIR?

The Adventures of Clair and CAM contains a collection of activities about air quality for elementary school students in grades K-5. These short, self-contained activities are correlated to the North Carolina Standard Course of Study in science, healthful living and social studies. Additionally, the activities are connected to a series of videos (available via DVD or streaming on YouTube). We recommend doing the activity, "What is Air," (K-2) or, "Air and the Respiratory System," (3-5) before watching the DVD. The other activities can be done following the DVD.

Teachers can meet North Carolina Professional Teaching Standards by incorporating The Adventures of Clair and CAM into classroom instruction. The air quality education imparted to teachers empowers them to advocate for changes at the school and at home to limit air pollution and protect student health. Children breathe at a faster rate than adults, taking in a higher volume of air. If that air is polluted, children can develop breathing problems or experience a worsening of pre-existing illnesses, such as asthma. We encourage you to familiarize yourself with this curriculum and to incorporate its activities into your teaching. The Adventures of Clair and CAM provides you and your students with an opportunity to become stewards of clean air and the knowledge to make choices that protect your health.

The primary goals of this curriculum are:

- ✓ To educate students about ways they can help prevent air pollution;
- ✓ To teach students to read and understand the daily air quality forecast code; and
- ✓ To demonstrate to students how to protect their health, especially on days when the air quality is poor.

The main focus of the curriculum is the impact of air quality on our health and the decisions we make to protect it. The health problems resulting from exposure to air pollution from birth to age 18 stay with us and can even shorten our life-span. Elementary-school students can play a key role in addressing the challenges of clean air and clean bills of health.

As they work through the curriculum, students will learn in simple and easily understood terms the properties of air and our need for it, as well as how the respiratory system works. They will learn about the things we do each day that contribute to air pollution and ways to contribute less through changes in our behaviors. Students will gain an understanding of the Air Quality Color Code that is used to communicate the air quality forecast and know how to use it to plan their outdoor activities and protect their health. They will learn that, by being informed, they can take action on their own to reduce air pollution and make safe choices when going outside. Best of all, they can pass along this knowledge to their families and friends!

VIDEOS

A series of short and fun videos featuring our mascots Clair, the clean air explorer, and CAM, the Clean Air Maniac, are an engaging way to help teach young students about air quality. The videos are designed to enhance the lessons and/or to reinforce the lessons learned from the activity you choose.

https://www.youtube.com/user/triangleairawareness/videos

You can find the videos online at http://triangleairawareness.org/cams-corner/

WHAT IS AIR POLLUTION?

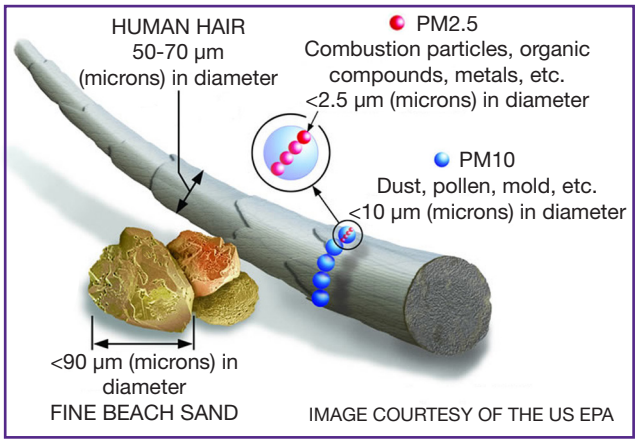
Air pollution refers to substances in the air (visible or invisible particles or gas) that cause health problems for people, animals and plants. It can reduce the yield of crops, discolor and damage buildings and outdoor sculptures and reduce visibility, impairing, for example, the view from scenic overlooks.

There are six air pollutants that have been designated as “criteria pollutants” by the US Environmental Protection Agency (EPA) including: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The EPA sets standards to protect health and welfare for each of these pollutants and require states to monitor for adherence. Two of the most problematic air pollutants in North Carolina are ozone and particulate matter (PM), also referred to as particle pollution. Ozone occurs both in the Earth's upper atmosphere and at ground level. Ozone can be good or bad, depending on where it is found:

- Good Ozone: Ozone occurs naturally in the Earth's upper atmosphere, 6 to 30 miles above the Earth's surface, where it forms a protective layer that shields us from the sun's harmful ultraviolet rays.
- Bad Ozone. In the Earth's lower atmosphere, near ground level (“ground level ozone”). Ozone is the by-product of a chemical reaction between nitrogen oxide (NOx) and volatile organic compounds (VOCs) that occurs in the presence of sunlight.

Remember, “Good up high, bad nearby.”

Sources of ground level ozone include: cars and trucks, power plants, industrial boilers, refineries, chemical plants and other sources.



- Particulate matter is a combination of solids and liquid droplets. Those less than10 micrometers in diameter (PM_{10}) are so small that they can get into the lungs, potentially causing serious health problems. Ten micrometers is smaller than the width of a single human hair.
- Fine particles ($PM_{2.5}$): Particles less than 2.5 micrometers in diameter are called "fine" particles. These particles are so small they can be detected only with an electron microscope.
- Coarse dust particles: Particles between 2.5 and 10 micrometers in diameter are referred to as "coarse."

Sources of PM2.5 include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning and some industrial processes. Sources of coarse particles include crushing or grinding operations and dust stirred up by vehicles traveling on roads.
[Source, EPA]

WHAT HEALTH PROBLEMS DOES AIR POLLUTION CAUSE?

Below is a list of some of the symptoms that appear in humans as a result of ozone and particle pollution. The majority of the symptoms affect the respiratory system.

- Burning eyes
- Coughing
- Throat irritation
- Tightness in the chest
- Rapid, shallow breathing
- Worsening of asthma
- Worsening of emphysema
- Bronchitis

Prolonged exposure to air pollution may result in:

- Permanent lung damage
- Increased susceptibility to respiratory infections
- Heart attacks, strokes or arrhythmia among people with heart disease

Children ages birth-18 (whose lungs are still developing) and older adults are at higher risk for health problems when exposed to air pollution, as are people who already have lung conditions, such as asthma, emphysema or chronic bronchitis or heart disease.

WHAT IS THE AIR QUALITY COLOR CODE?

Air pollution is often, though not always, invisible. For this reason, there is a color-coded air quality forecast each day to let the public know what sort of air quality to expect.

Air Quality Index (AQI Values) ***When the AQI is in this range:***	**Levels of Health Concern** ***...air quality conditions are:***	**Colors** ***..as symbolized by this color:***
0 - 50	**Good**	**Green**
51 - 100	**Moderate**	**Yellow**
101 - 100	**Unhealthy for Sensitive Groups**	**Orange**
151 - 200	**Unhealthy**	**Red**
201 - 300	**Very Unhealthy**	**Purple**

[Source: airnow.gov]

Fortunately, Code Purple days are very rare. However, many parts of the United States experience one or more Code Red days per year.

HOW DO I USE THE AIR QUALITY FORECAST?

Use the air quality forecast to determine the following:

- If it's safe to play outside, or if playing games or exercising indoors is the safer choice.
- How long to play outside.
- What time of day to play outside.
- What kinds of activity to engage in outside.
- What level of intensity of play is safe to engage in outside.
- If special considerations need to be given to students with asthma or other respiratory problems.

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	No health effects expected.
Moderate	51 to 100	Unusually sensitive people: consider limiting prolonged or heavy exertion outdoors.
Unhealthy for Sensitive Groups	101 to 150	Children, active people, older adults, and those with heart or lung disease (like asthma): limit prolonged or heavy exertion outdoors.
Unhealthy	151 to 200	Children, active people, older adults, and those with heart or lung disease (like asthma): avoid prolonged or heavy exertion. Everyone else: limit prolonged or heavyexertion outdoors.
Very Unhealthy	201 to 300	Everyone: avoid all exertion outdoors.

[Source: airnow.gov]

WHERE CAN I FIND THE AIR QUALITY FORECAST?

- Triangle Air Awareness: www.triangleairawareness.org
- NC Division of Air Quality's air quality forecasts page: www.ncair.org
- EPA: www.airnow.gov
- EnviroFlash: www.enviroflash.net Receive daily air quality forecasts or alerts (Code Orange forecasts or higher) by e-mail.
- TV: Local meteorologists include the air quality forecast in their weather reports.
- Newspapers: Newspapers publish the air quality forecast on their weather page.

HOW CAN I PREVENT AIR POLLUTION?

1. Drive less.

Cars and trucks are among the largest sources of air pollution in North Carolina. One way to lower the amount of emissions from these vehicles is to drive less. Below are some suggestions for curbing air pollution from your families' car or truck:

- ✓ Use alternative transportation. Walk, run, bike, carpool, vanpool or use mass transit.
- ✓ Turn off your engine when your car is stopped. Idling, or leaving your engine running when your car is stopped, wastes fuel and is harmful to your car. For every two minutes a car is idling, it uses about the same amount of fuel it takes to go about one mile. When you idle, you get zero miles per gallon.

2. Save electricity at home and at school.

The biggest source of electricity in North Carolina is power plants. Many power plants burn fossil fuels, which release a variety of pollutants into the air, including NOx and VOCs.

- ✓ Turn off lights, TVs and computers when not in use.
- ✓ Replace incandescent bulbs with compact fluorescents.
- ✓ Recycle.
- ✓ Take shorter showers to save the energy used to heat water.
- ✓ Set your thermostat a few degrees higher than normal in summer and a few degrees lower in winter.

3. Don't burn outdoors.

Smoke contains particle pollution that worsens air quality.

- ✓ Don't burn leaves or trash.
- ✓ Limit your use of fireplaces and charcoal grills.

4. Spread the word!

You're already doing your part to prevent air pollution by incorporating this curriculum into your lessons. We encourage you and your students to take the lessons you learn through the activities in this book and share them with parents and friends so that we may all take action to prevent air pollution!

Grades K-2 ACTIVITY: 1

WHAT IS AIR?

SUMMARY

Through a teacher demonstration, students will learn that air can take up space and lift up a book. Students will review the fact that humans, like all living things, need air to live. Students will learn that you can't always tell that air is dirty by looking at it.

MATERIALS

One or more gallon zip lock bags, sprig of lavender, rosemary or other fragrant plant or herb, drinking straw, tapematch (optional), book

ESSENTIAL QUESTIONS

1. What is air?
2. Why do we need air?
3. What does dirty air look like?

NC Essential Standards

Grade 1 Science

1.L.1.1

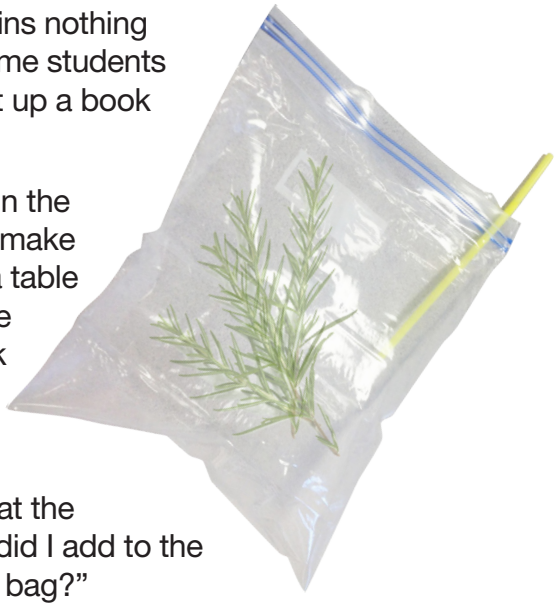
1.L.2.1

1.L.2.2

Time Needed

10-20 minutes

WHAT IS AIR?



Hold up a 1-gallon zip lock bag that is open and contains nothing but air. Ask students to tell you what is in the bag. Some students may say, "Nothing!" Ask if you can use "nothing" to lift up a book from a table?

Press all the air out of the bag. Put the drinking straw in the bag, and close the bag around the straw. Use tape to make the closure as air-tight as possible. Place the bag on a table with a book on top of it. Blow air into the bag using the drinking straw. When the bag is full of air and the book has been lifted off the table, slip the straw out, and close the bag completely. Ask the students again, "What is in the bag? What is holding the book off of the table?" If students say, "The bag," remind them that the bag was not able to lift the book by itself. Ask, "What did I add to the bag that lifted the book off of the table? What is in the bag?"

WHY DO WE NEED AIR?

We use air in many ways every day, including to keep our car tires inflated, but for the purposes of discussion, focus on breathing. Ask the class to name some things that humans couldn't live without: water, food and air. People can live for several weeks without food, several days without water, but we can't last more than a few minutes without air. If it's appropriate for your class, ask students to try holding their breath for a few moments. It starts to feel very uncomfortable, doesn't it? Ask students to think of other living things that need air.

WHAT DOES DIRTY AIR LOOK LIKE?

Put a sprig of lavender or rosemary (or other fragrant plant or herb) in a gallon zip lock bag. Inflate the bag with a drinking straw and seal it. Let the bag sit for several minutes, or longer, so that fragrance can evaporate from the sprig into the bag. Then remove sprig. Hold the bag up for the children to see, and ask whether the air in the bag is clean? What makes them think so? Children may say that the air in the bag is clean, because it looks clear. Let the children smell the air inside the bag. The sprig is giving off invisible chemicals in gaseous form that cause the air in the bag to smell. Even though the air in the bag looks clear and clean, it contains some smelly chemicals. In the same way, air that looks clean can contain air pollution.

Sometimes, polluted air does look dirty. To demonstrate this, light a match, blow it out and hold it in the bag for a moment to release some smoke into the bag. Now the air in the bag is dirty, and it looks dirty. Smoke is unhealthy to breathe. Ask your students if they have ever seen dirty air? Perhaps they have seen a smoky fire? Or maybe they have seen brownish haze in the summer?

WHAT IS AIR? ASSESSMENT

TO REVIEW:

Either in a class discussion or in writing, ask the students to tell you three things they know about air. Possible answers: air is all around us; we breathe air; we can't live without air; air contains oxygen; air can fill up a bag and hold up a book; plants need air. Ask, "What does dirty air look like?" Answer: Dirty air can look clear or dirty.

Reference

Invitations to Science Inquiry, second edition, Tik L. Liem, 1987.

Grades K-2 ACTIVITY: 2

IS THE AIR CLEAN TODAY? KNOW THE CODE!

SUMMARY

Students will learn how to find out whether the air is clean or dirty by checking the Air Quality Color Code forecast. They will learn what kinds of activities are healthy on days with an Air Quality Color Code of red or green.

MATERIALS

Air Quality Color Code poster (Available at www.ncair.org.)

Markers, crayons or colored pencils

Student coloring sheet, two per student (provided)

For optional activity: Old magazines, scissors and glue

ESSENTIAL QUESTIONS

1. How can we tell if the air outside is dirty?
2. How can we use the Air Quality Color Code to choose healthy activities?

NC Essential Standards

Kindergarten Science

K.E.1.2

K.E.1.3

Kindergarten Health Education

K.PCH.2.4

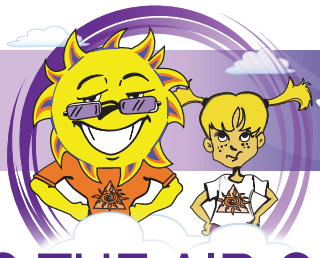
Grade 1 Health Education

1.NPA.3

Time Needed

Game: 15-20 minutes

Drawings: 15 minutes



IS THE AIR CLEAN TODAY? KNOW THE CODE!

HOW CAN WE TELL IF THE AIR OUTSIDE IS DIRTY?

Humans can't live without air. Yet sometimes our air contains substances that make it unhealthy for humans, other animals and plants. Polluted air can make our eyes burn or cause us to cough or breathe faster than normal, and it also increases the risk of asthma attacks. Many of the health effects of polluted air are temporary, but regular exposure to polluted air over time can cause permanent problems, such as damage to the lungs and cardiovascular system. [See "Air Quality Basics for Teachers" on page 1 for more information about the health effects of air pollution.]

When the air is unhealthy, we can protect ourselves by staying indoors and/or avoiding strenuous exercise while outdoors. But how do we know whether the air is clean or polluted? Sometimes polluted air looks dirty, but sometimes it looks just fine. The way to find out is to check the air quality forecast, also know as the Air Quality Color Code. The forecast is color-coded to make it easy to remember.

HOW CAN WE USE THE AIR QUALITY COLOR CODE TO CHOOSE HEALTHY ACTIVITIES?

Review the Air Quality Color Code with your students. If practical, display the EPA's Air Quality Color Code poster in your classroom. To help students remember the code, use "Green means go. Red means stop." Green means the air is clean and outdoor activity is safe and healthy. Red means the air is not clean, and outdoor activity may cause health problems—these problems could be minor or serious depending on the health and sensitivity of the individual. (Purple air quality is even worse, but it is quite rare.)

A GREEN forecast means the air is clean, and it's safe for everyone to exercise vigorously outdoors.

A YELLOW forecast means the air is pretty clean and it's safe for almost everyone to exercise outdoors. There may be some very sensitive individuals who would feel some effects.

An ORANGE forecast means the air is polluted enough that sensitive individuals, such as those with asthma or other health issues, should limit their outdoor activity.

A RED forecast means everyone should take it easy if they are outdoors. Sensitive individuals should stay inside.

A PURPLE forecast means everyone should stay avoid all exertion outdoors until the air clears.

WHOLE-BODY AIR QUALITY GAME

To review the Air Quality Color Code, go outside or to the gym where students can move around freely. When you clap your hands or blow a whistle, the student that you point to should ask loudly, "Teacher, what is the air quality today?" You call out one of the four colors: green, yellow, orange or red. Depending on the color you say, the children should respond as shown below, until you clap your hands or blow a whistle again.

GREEN and YELLOW: Children run, hop, gallop or skip.

ORANGE: Children walk.

RED: Children sit and hold their hands to mime reading a book.

GREEN DAY AND RED DAY DRAWINGS

Give each child two coloring sheets: one showing Clair and one of CAM (provided). Ask students to color Clair's name green (to represent a Green, or good day) and draw a picture of someone playing vigorously outdoors next to Clair. Next, ask students to color CAM's name red (representing a code Red day, or poor air quality day) and draw a picture of someone participating in activities indoors, such as cooking, playing an instrument or drawing.

Optional: For older children, you may wish to provide them with magazines and have them look for and cut out pictures of appropriate activities for green and red Air Quality Color Codes.

TODAY'S AIR QUALITY COLOR CODE

Share today's air quality forecast with the class and discuss how the class should respond to the forecast. If it's green or yellow, full speed ahead! But if it's orange or red, you may want to have recess in the morning before air pollutants have built up or have recess in the gym.

You can find the air quality forecast on the TV weather forecast segments, in some newspapers (usually on the weather page) or on any of the following websites:

Triangle Air Awareness
www.triangleairawareness.org

North Carolina Division of Air Quality
www.ncair.org

US EPA's Air Now
www.airnow.gov

EnviroFlash (to receive forecasts by email)
www.enviroflash.info

CLAIR THE CLEAN AIR EXPLORER

CLAIR
THE CLEAN AIR
EXPLORER

CAM THE CLEAN AIR EXPLORER

Grades K-2 ACTIVITY: 3

HOW CAN WE HELP CLAIR AND CAM PREVENT AIR POLLUTION?

SUMMARY

Students will work together to create a bulletin board with the title, “Help Clair and CAM Prevent Air Pollution.”

MATERIALS

Art supplies

Writing supplies

Old magazines

Line drawings of Clair and CAM (provided)

ESSENTIAL QUESTIONS

1. What are sources of air pollution?
2. What are some things we can do to help prevent air pollution?

NC Essential Standards

Grade 1 Science

1.L.1.3

Grade 1 Social Studies

1.G.2.1

1.G.2.2

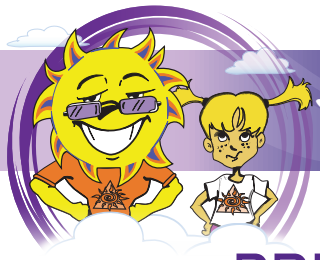
Grade 2 Social Studies

2.G.2.1

2.G.2.2

Time Needed

20-30 minutes



PREVENT AIR POLLUTION

WHAT ARE SOURCES OF AIR POLLUTION?

Ask your students if they know some sources of air pollution. Air pollution comes from a lot of sources, but for this activity, focus on two primary sources: vehicles and things that use energy (including electricity). Students may be able to come up with the idea that cars, trucks and buses create air pollution, because they may have seen dirty air coming out of the tailpipes. Other uses of energy, such as electricity, are more abstract, because in most cases, it's out of sight, out of mind.

Much of our energy comes from burning fossil fuels. Many people heat their homes by burning natural gas or oil in a furnace. Some electricity comes from power plants that burn coal or natural gas to make electricity. [See "Air Quality Basics for Teachers" on page 1 for more information about sources of air pollution.]

WHAT ARE SOME WAYS THAT WE USE ENERGY EVERY DAY?

Students should be able to tell you ways they use gasoline-powered transportation (cars, buses, planes, motor boats, ATVs , etc). Thinking of ways they use electricity and other forms of energy may be harder, so work as a class to make a list. If they need help, suggest thinking of things they use that need to be plugged in. Here are some ideas:

- Using electric lights, television, and computers.
- Air conditioning your house or apartment.
- Heating your house or apartment.
- Mowing the lawn.
- Using dish washers, washing machines and clothes dryers.
- Keeping food cold or frozen in the refrigerator or freezer.
- Cooking with a stove or oven.
- Using hot water.
- Using miscellaneous electric appliances, such as: toasters, blenders, microwaves, hair dryers, paper shredders, electric pencil sharpeners, fans, space heaters and electric alarm clocks.

IF WE DRIVE LESS AND SAVE ELECTRICITY, WE PREVENT AIR POLLUTION!

Remind children that driving cars and using electricity causes air pollution. Ask them if they can think of ways to prevent pollution. As a class, make a list on the board. Here are some ideas:

Drive less:

- Bike or walk when it's safe to do so.
- Carpool.
- Ride the school bus, instead of driving.
- Turn off the car; park and go inside restaurants, banks, etc., instead of using drive-throughs.

Save electricity at home and at school:

- Turn off lights, computers and TVs when not in use. Anything that still gives off light after being turned "off" is using electricity. This is called "ghost electricity." If you see a light on a electric device you've turned off, unplug it when not in use.
- Use compact fluorescent light bulbs (the ones that look like spirals) or LED bulbs, because they use less electricity and last longer.

CFL & LED Bulbs

- Recycle. It takes less energy to make paper from paper than to make paper from trees.

- Use less hot water. Try taking a 5-minute shower, and ask your parents, brothers and sisters to do the same.
- Don't overheat or overcool the house.
- Don't burn leaves or trash. Burning leaves and trash produces particle pollution and toxic emissions. In North Carolina, the law is, if you can't grow it, don't burn it!
- Limit the use of wood-burning fireplaces and charcoal grills.

CREATE A CLASSROOM DISPLAY ABOUT CLAIR AND CAM.

Create a classroom bulletin board or poster with the title, "Help Clair and CAM Prevent Air Pollution," using pictures, collages and writing done by the children, as well as the line drawings of Clair and CAM (provided). If practical, put the display in the hall or media center for other classes to enjoy. You could simply ask each child to draw a picture of one way of preventing air pollution by saving energy. You could incorporate more variety by asking some students to contribute written lists of ways to prevent air pollution.

Grades 3-5 ACTIVITY: 1

AIR AND THE RESPIRATORY SYSTEM

SUMMARY

Through simple classroom demonstrations, students will learn that air takes up space and has weight. Students will also discuss the ways humans depend on air and will review the functioning of the respiratory system.

MATERIALS

Large, clear container (aquarium, plastic storage bin), cup (preferably clear), paper towel, yardstick, two balloons, thread, scissors, straight pin, handout: Our Respiratory System (provided)

ESSENTIAL QUESTIONS

1. What are some of the properties of air?
2. Why do we need air?

NC Essential Standards

Grade 3 Science

3.P.2.1

Grade 3 Healthful Living

3.PCH.1

Grade 4 Healthful Living

4.PCH.2

Grade 5 Healthful Living

5.PCH.4

Time Needed

30-45 minutes

AIR AND THE RESPIRATORY SYSTEM

WHAT IS AIR?

Many people think of air as "nothing" or "empty space," but that's not true. Air is a gas. It is actually a mixture of gases: 78 percent nitrogen, 21 percent oxygen and less than 1 percent argon. Here are two easy demonstrations to show your students two of the properties of air: it takes up space and it has weight.

1. **Demonstration: Air Takes Up Space**

   Pour water into a large, clear container. Put a balled-up paper towel in the bottom of the cup, stuffed in tightly enough so that it will stay when you hold the cup upside down. (You may need to gently squeeze the bottom of the cup during the experiment to keep the paper towel from loosening.) Hold the cup upside down over the container. Ask the students what is in the cup, besides the paper towel. They will probably say, "Nothing!"

   While still holding the cup upside down, lower it into the water, making sure the cup is upright and not held at an angle. No water goes into the cup, and the paper towel stays dry.

   Now use a pen or pencil to punch holes in the bottom of the cup. Do the experiment again. This time, water will go into the cup, and the paper towel will get wet.

   Ask the students if they can explain what happened. The first time the cup was lowered into the water, water could not go into the cup, because the cup was full of air. When you punched holes in the bottom of the cup and lowered it into the water, the air in the cup escaped through those small holes, and water could easily fill up the cup, getting the paper towel wet.

2. **Demonstration: Air Has Weight**

   Blow up two equally-sized balloons equal amounts. Use thread to tie each one to separate ends of a yardstick. Tie a piece of thread or string around the center of the yardstick so that the two balloons balance out the yardstick. Now use a pin to let the air out of one of the balloons. If you prick it near the knot, the balloon will fizzle, instead of popping. The side of the yardstick with the full balloon will now fall like a see-saw. Ask the students to explain. It's because the full balloon weighs more than the empty balloon because air has weight.

HOW DO WE USE AIR? THE RESPIRATORY SYSTEM

We use air in many ways every day: to keep our car and bike tires inflated, to blow-dry our hair and to blow leaves. The most important way we use air every day is to breathe! Ask the class to name some things that humans couldn't live without: water, food, and air.

People can live for several weeks without food and several days without water, but we can't last more than a few minutes without air. Ask students to try holding their breath for a few moments. It starts to feel very uncomfortable, doesn't it? Ask students to name some other living things that need air.

Humans need air because we need the oxygen that is in it. We breathe the air into our lungs and our lungs transfer oxygen from the air into our blood, which our heart sends around to every part of our bodies. All of our cells need a steady supply of oxygen in order to function.

HOW THE RESPIRATORY SYSTEM WORKS

Depending on the age and abilities of your students, review either the simple or the more complex explanation of the respiratory system.

Simple explanation:

- Your lungs expand and fill with air when the muscle below your lungs, called the diaphragm, moves down.
- Air rushes into your lungs through your windpipe, also called the trachea.
- From the trachea, air goes into each lung through many branching tubes.
- In the lungs, your body takes oxygen out of the air and adds carbon dioxide to it.
- Your diaphragm pushes up, making your lungs get smaller and forcing the air out. The air you exhale has a lot of carbon dioxide and not much oxygen in it.

More complex explanation:

- Your lungs expand and fill with air when the muscle below your lungs, called the diaphragm, moves down.
- Air rushes into your lungs through your windpipe, also called the trachea.
- From the trachea, air goes into each lung through many branching tubes. The smallest ones are called bronchioles.
- Each bronchiole ends in tiny air sacs called alveoli.
- In the alveoli, oxygen moves from the air into tiny blood vessels, called capillaries. At the same time, carbon dioxide (a waste product) moves from the blood vessels into the air in the alveoli.
- The blood, now full of oxygen, goes to the heart, where it is pumped to all parts of the body.
- Your diaphragm pushes up, making your lungs get smaller and forcing out the air. The air you exhale has a lot of carbon dioxide and not much oxygen in it.
- Your diaphragm goes down, and you take in a fresh breath of air, beginning the cycle anew.

INTERDEPENDENCE OF PLANTS AND ANIMALS

Respiration is a good example of how plants and animals are interdependent. Animals need oxygen (O^2), which is given off by plants, and plants need carbon dioxide (CO^2), which is given off by animals.

Animals, including humans, breathe in oxygen and breathe out carbon dioxide. To be more precise: we breathe in air containing primarily nitrogen; our bodies remove a lot of the oxygen; then we breathe out air that is rich with carbon dioxide.

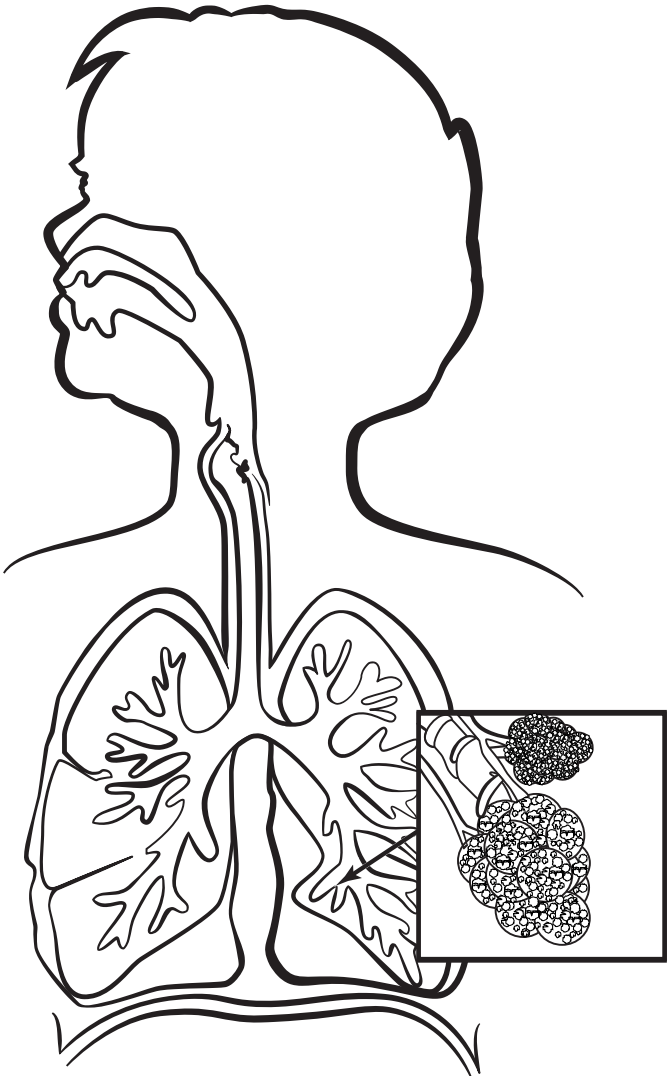
Plants use carbon dioxide and give off oxygen as part of photosynthesis. To be more precise, plants take carbon dioxide (CO^2) out of the air; remove the carbon to use to make leaves, roots, and stems; and give off the leftover oxygen (O^2).

RESPIRATORY SYSTEM HANDOUT

Give your students the handout titled, "Our Respiratory System", and ask them to answer the questions on the handout.

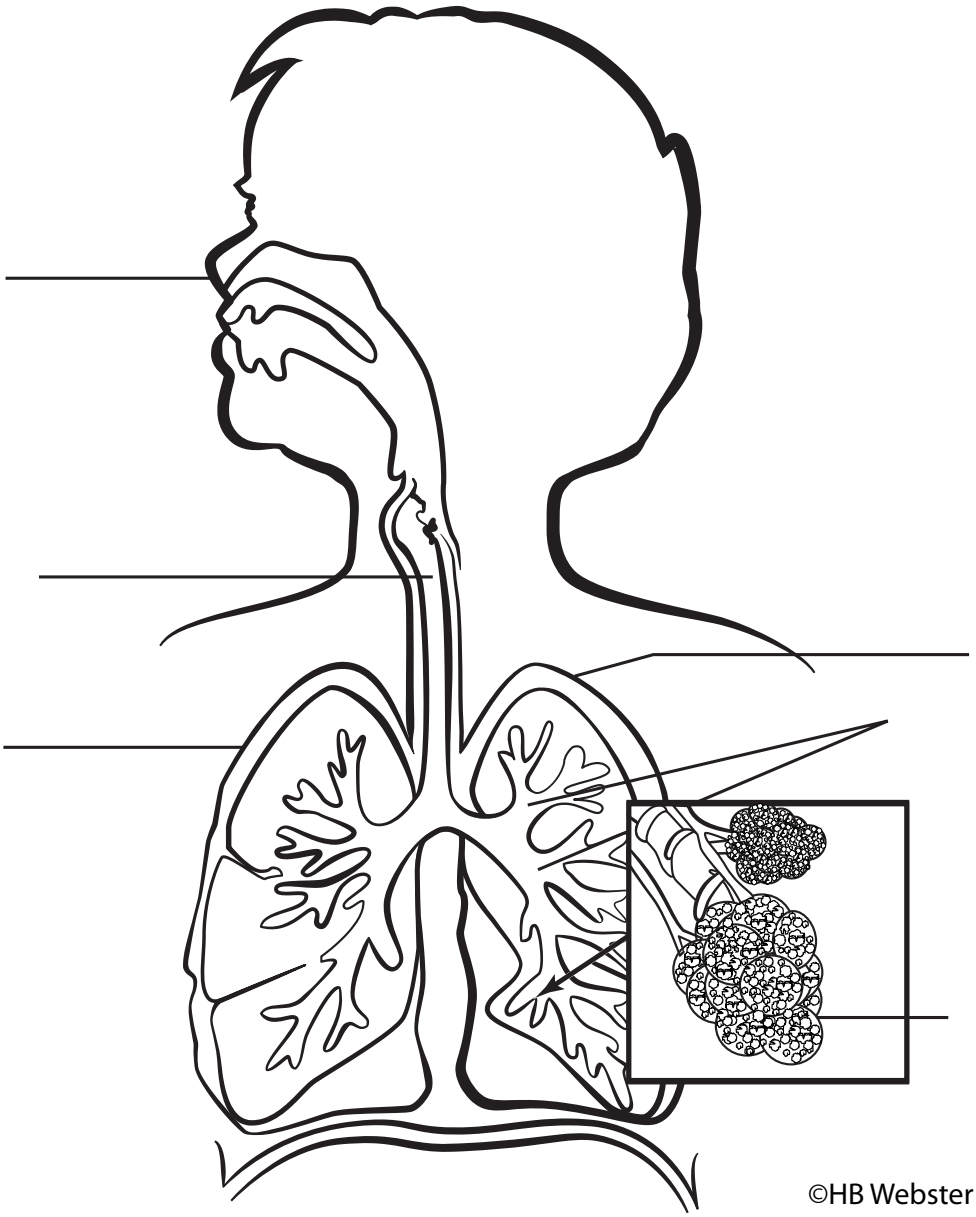
Source

The balloon activity came from a US EPA air quality workshop. EPA credits Invitations to Science Inquiry, second edition, Tik L. Liem, 1987, as the source of the idea.



RESPIRATORY SYSTEM

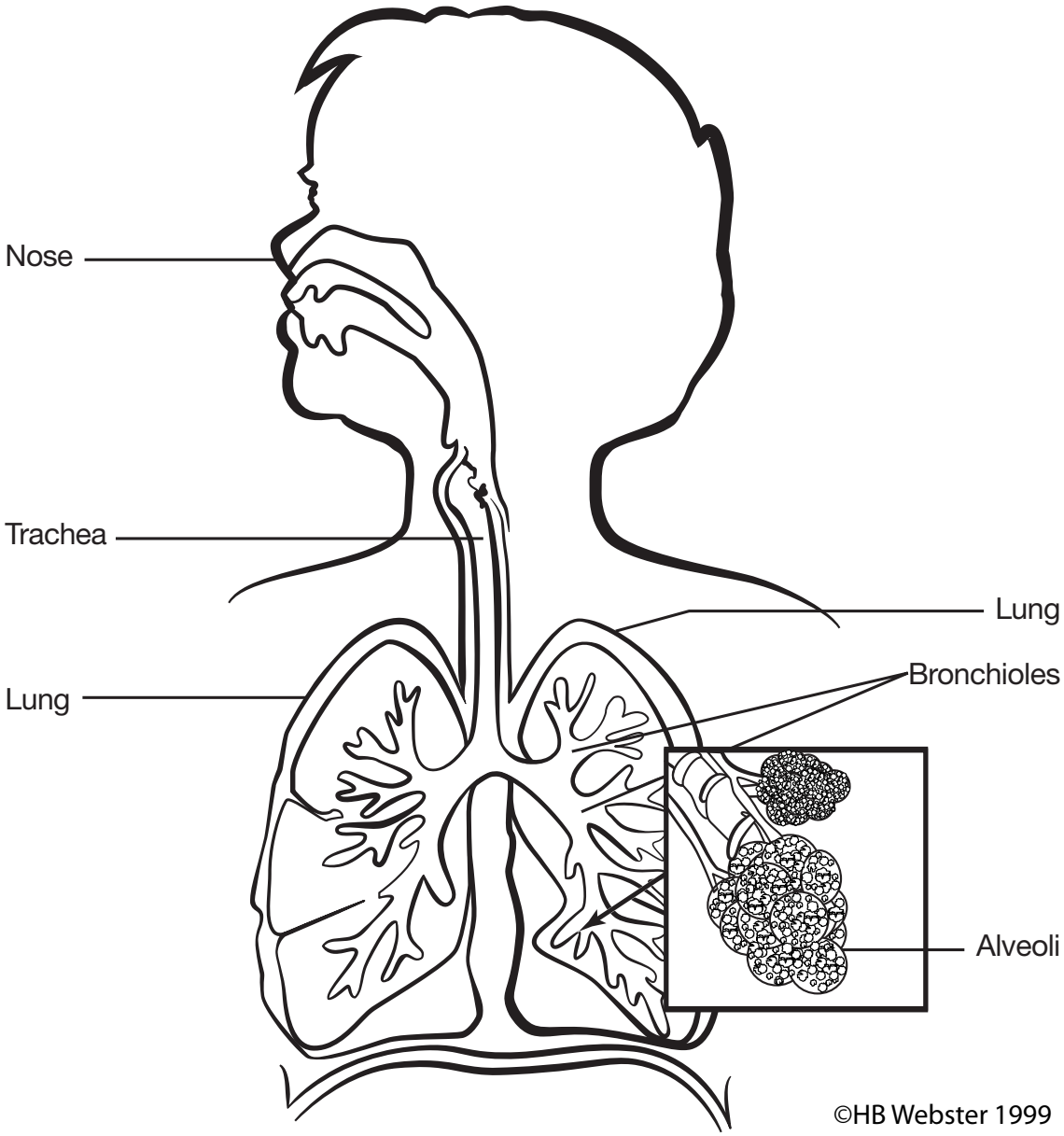
Name _____ Date _____



1. Label the lungs, bronchioles and alveoli in the picture.
2. Air enters our lungs through a tube called the _____
   Label this tube on the picture.
3. What gas do our lungs take out of the air for use by our bodies?

   _____
4. What gas do we breathe out of our lungs? _____

ANSWER KEY



1. Label the lungs, bronchioles and alveoli in the picture.
2. Air enters our lungs through a tube called the trachea . Label this tube on the picture.
3. What gas do our lungs take out of the air for use by our bodies?

   Oxygen
4. What gas do we breathe out of our lungs? Carbon Dioxide

Grades 3-5 ACTIVITY: 2
THE PLASTIC BAG AIR LIFT

SUMMARY

Students will learn that air, when compressed, exerts pressure. Students will inflate garbage bags to lift a table with a student or teacher sitting on it.

MATERIALS

12-20 Garbage medium-sized, plastic garbage bags

2 identical flat-top tables

ESSENTIAL QUESTIONS

1. Can air be compressed?
2. How does compressed air compare to atmospheric air?

NC Essential Standards

Grade 3 Science

3.P.2.1

Note: While there are no Essential Standards paired with this activity for 4th and 5th grades, this experiment is great fun for all—even teachers!

Time Needed

20-30 minutes

THE PLASTIC BAG AIR LIFT

1. Ask as many students as can possibly fit to stand around a table and give each student a plastic bag.
2. Have the students spread out the bags on the table and hold the bag's mouth in their hands to get set to blow air into them. (Students will need to squat around the table and stay in that position until the end of the activity.)
3. Make sure that all students are ready to blow air into the bags with hands and fingers away from the table top.
4. Ask two or four other students to lift the other identical table, turn it upside down and place it slowly on the first table. (This has to be done carefully, as it has to move over the heads of the students holding the bags.)
5. Ask one student to climb up and sit on top of the set of tables.
6. Station four students around the table in opposing positions to spot the student sitting on the table.
7. On the count of three, instruct the squatting students to blow air in the plastic bags *Note: Trying to get the students to work together to blow at the same time.*

Questions:

1. Did you expect a heavy weight like that to be lifted by air?
2. What made the top table rise?
3. Can you think of other times you've seen air lift something?
4. How did the pressure of the air inside the plastic bags compare to the air pressure outside of the bags?

Explanation:

By blowing into the plastic bags, air is being compressed. This compressed air is exerting pressure underneath the inverted table causing the table to rise. This principle is being applied when pumping tires of a bicycle or an automobile, or compressing air in air lifts (at gas stations or garages). Tire pressures are 2 to 4 times higher than the atmospheric/outdoor air pressure.

References

Invitations to Science Inquiry, second edition, Tik L. Liem, 1987.

Grades 3-5 ACTIVITY: 3

USING THE AIR QUALITY COLOR CODE TO STAY HEALTHY

SUMMARY

Students will learn about the Air Quality Color Code and some of the health problems caused by pollution. They will review what they've learned by completing a word game and/or making an origami "fortune teller" with questions and answers about the Air Quality Color Code.

MATERIALS

Air Quality Index poster (available from EPA's AirNow.gov website)

Clair and CAM's Air Quality word game (provided)

Pattern for making a Clair and CAM Air Quality "fortune teller" (provided)

ESSENTIAL QUESTIONS

1. How can we find out if the air is clean or dirty?
2. How can we use information about air pollution to stay healthy?

NC Essential Standards

Grade 3 Social Studies

3.C&G.2.2

Grade 3 Healthful Living

3.PCH.1

Grade 4 Science

4.L.1.1
4.L.1.3

Grade 4 Social Studies

4.G.1.2
4.G.1.4

Grade 4 Healthful Living

4.PCH.1
4.PCH.4

Grade 5 Science

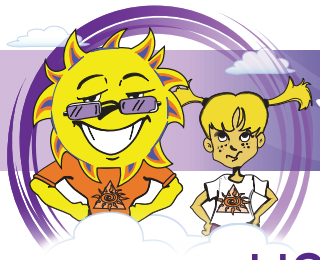
5.E.1.1
5.E.1.2

Grade 5 Social Studies

5.G.1.2

Time Needed

Word game: 10 minutes
Origami: 15 minutes



USING THE AIR QUALITY COLOR CODE TO STAY HEALTHY

Using "Air Quality Basics for Teachers", discuss with the class:

- ✓ The definition of air pollution,
- ✓ Health problems caused by air pollution and
- ✓ The Air Quality Color Code.

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	No health effects expected.
Moderate	51 to 100	Unusually sensitive people: consider limiting prolonged or heavy exertion outdoors.
Unhealthy for Sensitive Groups	101 to 150	Children, active people, older adults, and those with heart or lung disease (like asthma): limit prolonged or heavy exertion outdoors.
Unhealthy	151 to 200	Children, active people, older adults, and those with heart or lung disease (like asthma): avoid prolonged or heavy exertion. Everyone else: limit prolonged or heavyexertion outdoors.
Very Unhealthy	201 to 300	Everyone: avoid all exertion outdoors.

[Source: airnow.gov]

Emphasize the Air Quality Color Code refers only to air pollution. It doesn't have any relationship to other forecasts sometimes given in the newspaper, such as the UV Index. The UV Index tells how strong the sun's rays will be on the Earth's surface. If you want to know how much sunscreen to use, look at the UV Index.

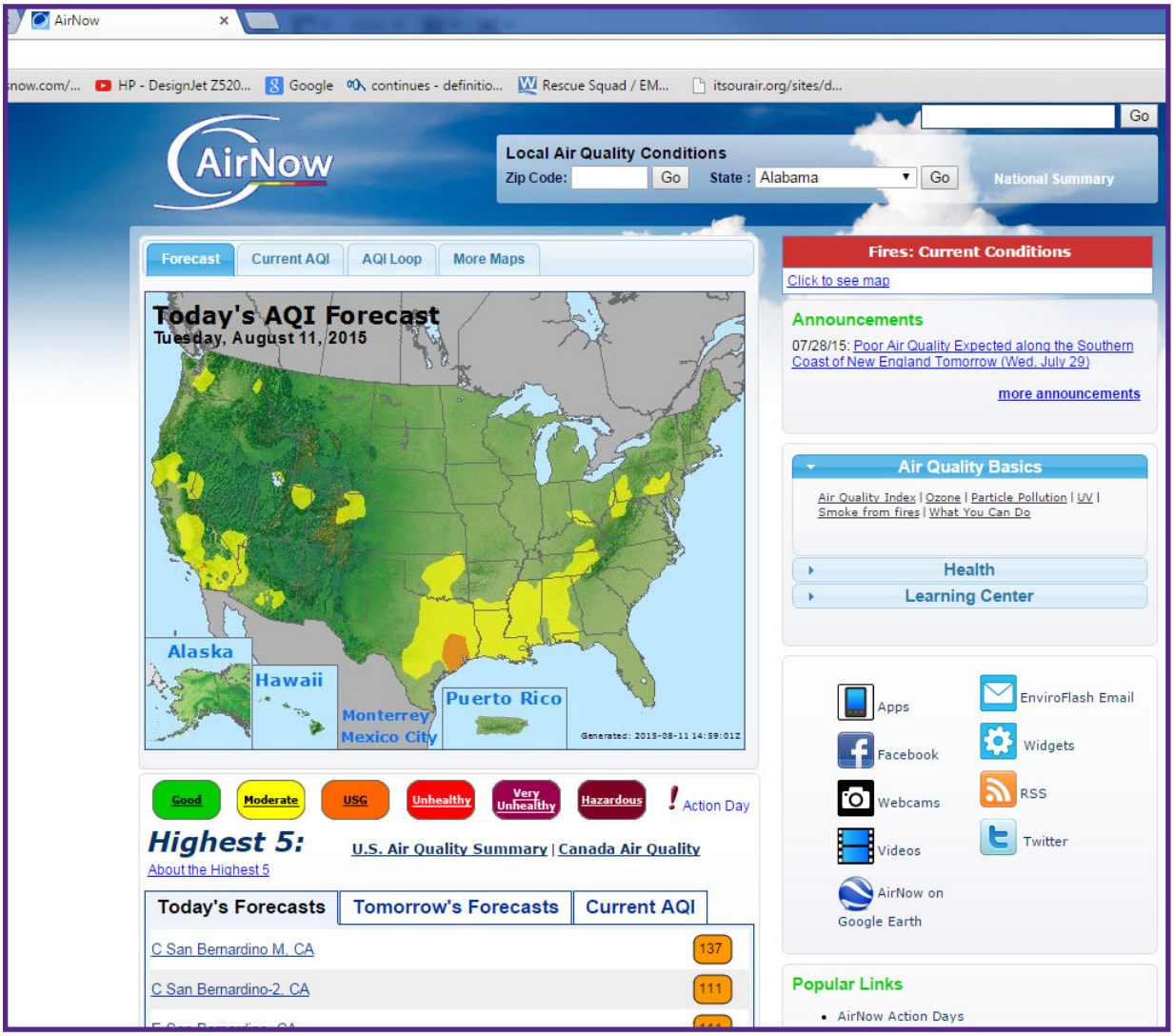
Make a list with the class of fun activities for days with poor air quality, such as swimming indoors, playing basketball in a gym, reading, cooking, doing art, making music, etc.

Have students review the material by completing the Air Quality Color Code word game handout and/or making and using an Air Quality Color Code "fortune teller."

Post the daily air quality forecast in your classroom. If the day's forecast is red, it may be a good idea to have recess in the morning, before pollutants have built up, or to have recess in the gym. If you have children in your classroom with asthma or other lung conditions, you may wish to use the same caution for orange days.

You can find the air quality forecast in the newspaper (usually on the weather page), hear/see it on TV news weather forecasts or at any of the following websites:

- www.triangleairawareness.org (Triangle Air Awareness)
- www.ncair.org (North Carolina Division of Air Quality)
- www.airnow.gov (US EPA)



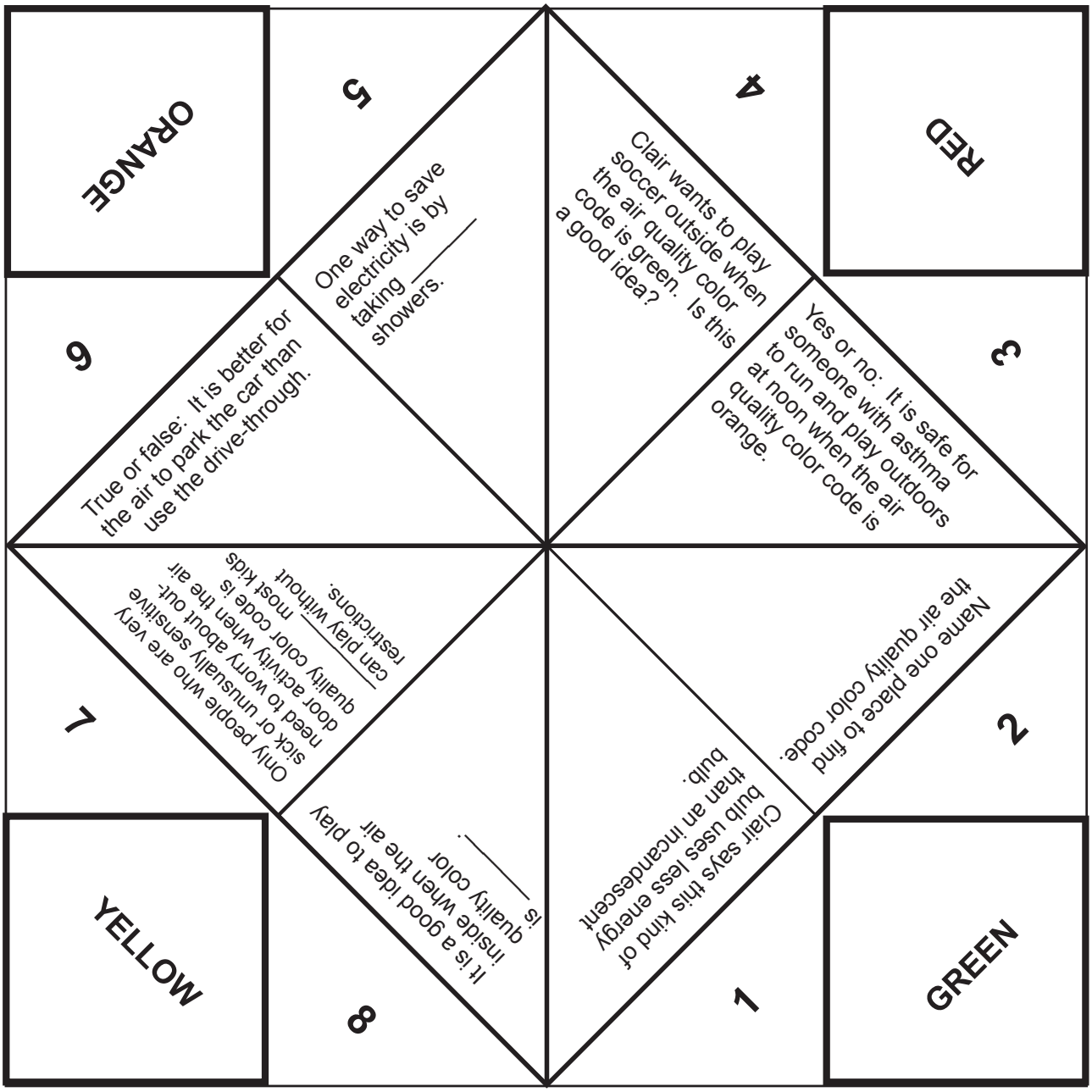
[Source: airnow.gov]

EPA offers a free app, AirNow, available on Apple and Android devices that can be used to find out the air quality forecast simply by entering in a zip code.

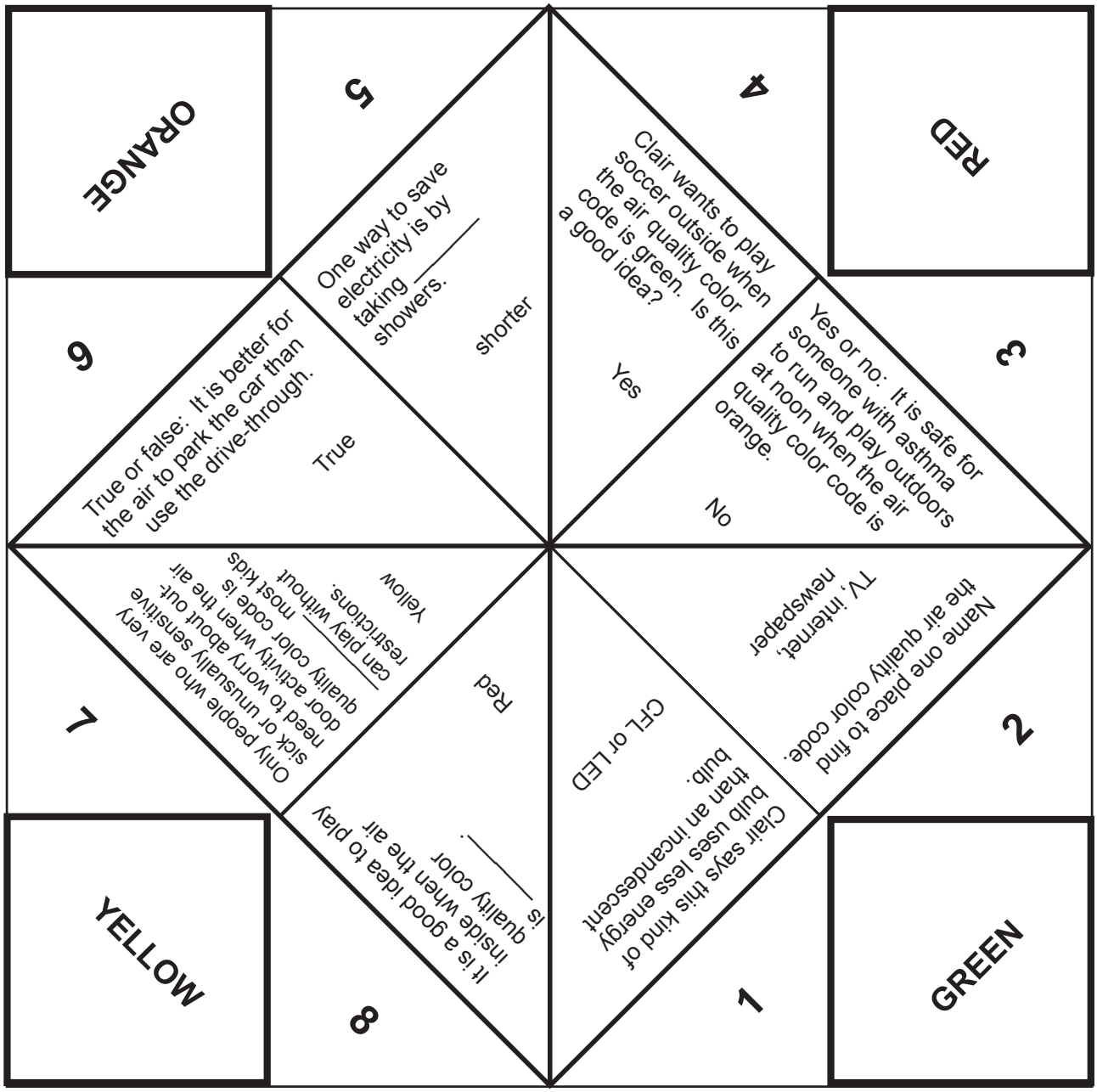
Available on the App Store

Get it on Google play

ORIGAMI


ORANGE
5
One way to save electricity is by taking ____ showers.
4
Clair wants to play soccer outside when the air quality color code is green. Is this a good idea?
RED
6
True or false: It is better for the air to park the car than use the drive-through.
3
Yes or no: It is safe for someone with asthma to run and play outdoors at noon when the air quality color code is orange.
7
Only people who are very sick or unusually sensitive need to worry about outdoor activity when the air quality color code is ____. most kids can play without restrictions.
2
Name one place to find the air quality color code.
YELLOW
8
It is a good idea to play inside when the air quality color is ____.
1
Clair says this kind of bulb uses less energy than an incandescent bulb.
GREEN

ORIGAMI ANSWER KEY



1. T.V. weather forecasts, internet, newspaper
2. Yellow
3. Compact fluorescent bulb (CFL) or LED
4. True
5. Shorter
6. Yes
7. Orange
8. False

Grades 3-5 ACTIVITY: 4

PREVENTING AIR POLLUTION BY SAVING ELECTRICITY AND DRIVING LESS

SUMMARY

Students will make ads communicating specific ways of preventing air pollution. Depending on the availability of supplies, technology and time, students can produce ads by making posters, brochures or skits (which could be videotaped).

MATERIALS

Line drawings of Clair and CAM (provided)

Art supplies to make posters, OR

Supplies to make brochures (paper, colored pencils), OR

Equipment to make videos

ESSENTIAL QUESTIONS

1. Where does air pollution come from?
2. How can we help prevent air pollution?
3. Why should we prevent air pollution?

NC Essential Standards

Grade 3 Social Studies

3.C&G.2.2

Grade 3 Healthful Living

3.PCH.1

Grade 4 Science

4.L.1.1
4.L.1.3

Grade 4 Social Studies

4.G.1.2

Time Needed

Varies depending on scope of activity.

PREVENTING AIR POLLUTION BY SAVING ELECTRICITY AND DRIVING LESS

USING "AIR QUALITY BASICS FOR TEACHERS," DISCUSS WITH THE CLASS:

- ✓ Sources of air pollution
- ✓ Ways to prevent air pollution and
- ✓ Some of the health effects of air pollution.

Air Pollution Prevention Tips

Drive less:

- Bike or walk, when it's safe to do so.
- Carpool.
- Ride the school bus, instead of driving.
- Turn off the car: park and go inside, instead of using the drive-through.

Save electricity at home and at school:

- Turn off lights, computers and TVs when not in use.
- Use compact fluorescent light bulbs (the ones that look like spirals) or LED bulbs, because they use less electricity and last longer.
- Recycle. (It takes less energy to make paper from paper than to make paper from trees.)
- Use less hot water.
- Don't overheat or overcool your house.

CFL bulbs contain a tiny amount of mercury—no more than the size of the tip of a ball point pen. Nonetheless, once burned out, CFL bulbs should be disposed of safely, not in the trash can. Most home improvement stores and some municipalities offer light bulb recycling programs, many of which require the bulbs not be broken.

CFL bulb and LEDs

LED

Don't make smoke!

- Don't burn leaves or trash.
  Burning trash is illegal in North Carolina. "If you can't grow it, you can't burn it." (To learn more visit: http://www.ncair.org/enf/openburn/education)
- Limit use of fireplaces and charcoal grills.

DESIGNING ADS WITH CLAIR AND CAM

Have students work individually or in small groups. Each individual or group should design an ad consisting of either a:

- Poster, plus a class presentation
- Brochure or
- Skit.

Encourage students to use the characters of Clair and CAM in the ads. Each ad should convey the following information:

- ✓ One or more specific tips for preventing pollution.
- ✓ Information about where air pollution comes from (focusing on cars andusing electricity).
- ✓ Information about why we should prevent air pollution, focusing on the health problems it creates.

Posters are usually most effective when they aim to get across one simple idea. Students doing a poster should limit the information on the poster to ONE tip for preventing air pollution. They should cover the other information in the class presentation.

CLAIR THE CLEAN AIR EXPLORER

CLAIR
THE CLEAN AIR
EXPLORER

CAM THE CLEAN AIR EXPLORER

Grades 3-5 ACTIVITY: 5
THE MAGIC SCHOOL BUS GETS CLEANED UP

SUMMARY

Students read "The Magic School Bus Gets Cleaned Up" (aloud or silently) and answer questions in a class discussion or in written format.

MATERIALS

Book: "The Magic School Bus Gets Cleaned Up" (provided)
Question sheet (provided)

ESSENTIAL QUESTIONS

1. Where does air pollution come from?
2. How can we help prevent air pollution?
3. Why should we prevent air pollution?

NC Essential Standards

Grade 3 Social Studies

3.C&G.2.2

Grade 3 Healthful Living

3.PCH.1

Grade 4 Science

4.L.1.1
4.L.1.3

Grade 4 Social Studies

4.G.1.2

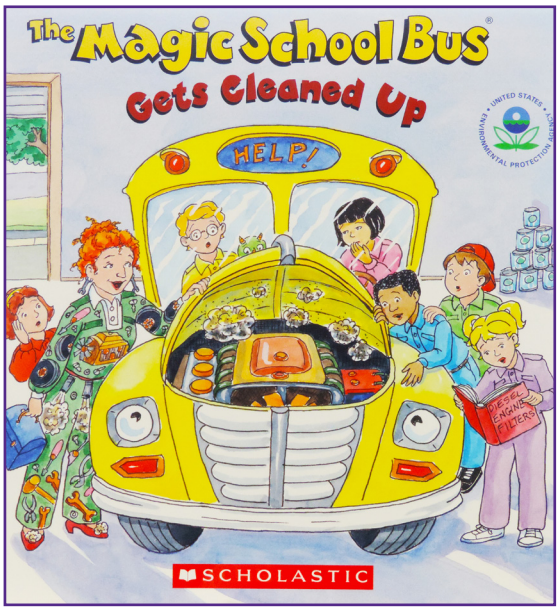
Time Needed

30-45 minutes

THE MAGIC SCHOOL BUS GETS CLEANED UP

Name _____ Date _____

Directions: Read, "The Magic School Bus Gets Cleaned Up," and answer the questions below.



1. What is air pollution?

2. What are two reasons why children are at risk from air pollution?

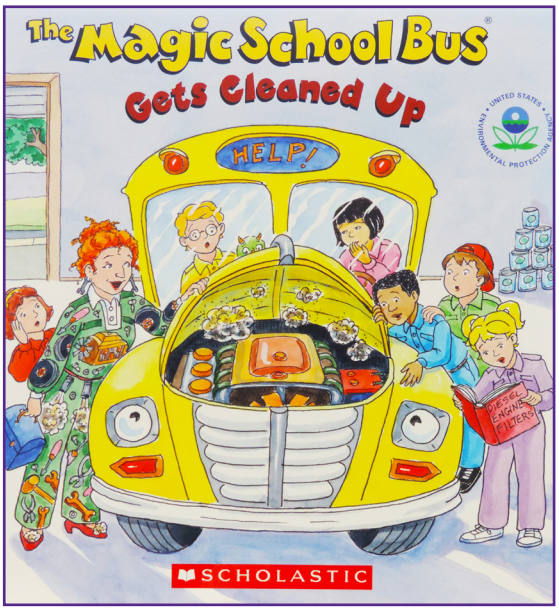
3. When the Magic School Bus became as tiny as a piece of particulate matter, where was the first place the bus went, and how did it get there? How did it get out?

4. Most cars run on gasoline. Most school buses run on diesel fuel. Name four other types of vehicles that run on diesel fuel.

5. What special device did Mr. Spencer install on the Magic School Bus? What does that device do?

TEACHER'S ANSWER SHEET

"The Magic School Bus Gets Cleaned Up"



1. **What is air pollution?**

   Air pollution consists of "substances in the air that cause problems for people and nature. It can be gases or bits of junk that can harm living things."

2. **What are two reasons why children are at risk from air pollution?**

   Children ages 0-18 are at risk from air pollution because their lungs are still growing and they take more breaths per day than adults.

3. **When the Magic School Bus became as tiny as a piece of particulate matter, where was the first place the bus went and how did it get there? How did it get out?**

   The Magic School Bus went into Mr. Rivera's lungs. Wind blew the bus into his nose, and the bus went down his windpipe when he inhaled. The school bus got out of his lungs when he exhaled as he blew his whistle.

4. **Most cars run on gasoline. Most school buses run on diesel fuel. Name four other types of vehicles that run on diesel fuel.**

   Other vehicles that use diesel fuel include trucks, trains, tractors, bulldozers, ships and dump trucks.

5. **What special device did Mr. Spencer install on the Magic School Bus? What does that device do?**

   Mr. Spencer installed a particulate matter filter on the Magic School Bus. It catches particulate matter and keeps it from going out the tailpipe and into the air.

Grades 3-5 ACTIVITY: 6

AIR QUALITY DISCUSSION/WRITING PROMPTS

SUMMARY

Below are questions that serve as extensions to the students' learning after having completed the preceding activities in this curriculum. Use of questions (as discussion prompts or writing prompts) may vary, depending upon grade level and writing proficiencies.

SUMMARY

Discussion/Writing prompts (provided)
Paper (if writing)
Pencil (if writing)

ESSENTIAL QUESTIONS

1. Where does air pollution come from?
2. How can we help prevent air pollution?
3. Why should we prevent air pollution?

NC Essential Standards

Grade 3 Social Studies

3.C&G.2.2

Grade 3 Healthful Living

3.PCH.1

Grade 4 Science

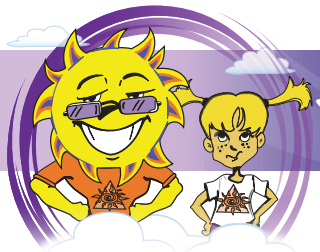
4.L.1.1
4.L.1.3

Grade 4 Social Studies

4.G.1.2

Time Needed

30-45 minutes



AIR QUALITY DISCUSSION/WRITING PROMPTS

1. What are some things you can do to help Clair and CAM keep the air clean? Give specific examples.

2. Pretend that you are Clair or CAM. Write a letter to a friend explaining why it is important to prevent air pollution.

3. Why do you think Clair and CAM want to teach people about the Air Quality Color Code?

4. Explain how helping to keep the air clean is an important part of good citizenship.

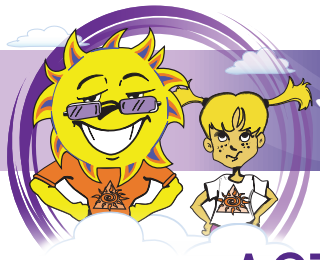
5. Do you think there should be laws against wasting energy? Why, or why not?

6. What are some things you know about air?

7. My favorite way of preventing air pollution is…

8. My favorite outdoor activity on days when the Air Quality Color Code forecast is green is…

9. Things I can do when the Air Quality Color Code forecast is red are…



ACTIVITY ANSWER SHEET

1.

2.

3.

4.

5.

6.

7.

8.

9.

NC ESSENTIAL STANDARDS

All of the NC essential standards are maintained by the Department of Public Instruction (DPI). Learn more or check for updated standards at http://www.dpi.state.nc.us/acre/standards/new-standards/

KINDERGARTEN

Earth Science: Earth Systems, Structures and Processes

K.E.1.2: Summarize daily weather conditions noting changes that occur from day to day and throughout the year.

K.E.1.3: Compare weather patterns that occur from season to season.

Health Education

Personal and Consumer Health

K.PCH.2.4: Identify appropriate responses to warning signs, sounds and labels.

GRADE 1

Life Science: Ecosystems

Objective 1.L.1.1: Recognize that plants and animals need air, water, light (plants only), space, food and shelter and that these may be found in their environment.

Molecular Biology

Objective 1.L.2.1: Summarize the basic needs of a variety of different plants (including air, water, nutrients and light) for energy and growth.

Objective 1.L.2.2: Summarize the basic needs of a variety of different animals (including air, water and food) for energy and growth.

Health Education

1.NPA.3: Remember fitness concepts to enhance quality of life.

GRADE 2

Social Studies

Geography and Environmental Literacy

2.G.2.1: Give examples of ways in which people depend on the physical environment and natural resources to meet basic needs.

2.G.2.2: Explain how people positively and negatively affect the environment.

GRADE 3

Science

Physical Science: Matter: Properties and Change

3.P.2.1: Recognize that air is a substance that surrounds us, takes up space and has mass.

Social Studies

Civics and Government

3.C&G.2.2: Exemplify how citizens contribute to the well-being of the community's natural environment.

GRADE 4

Healthful Living

4.PCH.1: Understand wellness, disease prevention and recognition of symptoms.

4.PCH.4: Understand necessary steps to prevent and respond to unintentional injury.

4.PCH.2: Understand body systems and organs, functions and their care.

Life Science: Ecosystems

4.L.1.1: Give examples of changes in an organism's environment that are beneficial to it and some that are harmful.

4.L.1.3: Explain how humans can adapt their behavior to live in changing habitats (e.g., recycling wastes, establishing rain gardens and planting native species to prevent flooding and erosion)

GRADE 5

Science

Earth Science: Earth systems, Structures, and Processes

5.E.1.1: Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation and temperature) and patterns.

5.E.1.2: Predict upcoming weather events from weather data collected through observation and measurements.

Social Studies

Geography and Environmental Literacy

5.G.1.2: Explain the positive and negative effects of human activity on the physical environment of the United States, past and present.

Healthful Living

5.PCH.4: Understand body systems and organs, functions and their care.

Life Science

5.L.1.2: Compare the major systems of the human body (digestive, respiratory, circulatory, muscular, skeletal and cardiovascular) in terms of their functions necessary for life.