N.C. Air Awareness Girl Scout Outreach Program

The N.C. Air Awareness Girl Scouts program seeks to raise awareness of air quality issues in our state, promote interest in environmental stewardship, and help Girl Scouts be leaders in their communities by taking actions to reduce air pollution. N.C. Air Awareness works with hundreds of students across the state to encourage actions to reduce harmful air pollution and improve the communities in which we all live. We've enhanced our outreach program to connect our current educational materials to the needs of Girl Scouts and Girl Scout leaders here in North Carolina. We encourage Girl Scouts and Scout leaders to use these resources in association with the established badge, journey, and award guides to improve air quality. Here, you will find a selection of activities that will satisfy Girl Scout badge and journey requirements and can be completed during a single troop meeting. These activities make direct connections with the "Breathe" journey for Cadettes, the "Get Moving" journey for Juniors, and the "SOW What?" journey for Seniors but can be used elsewhere if appropriate.

Included Activities

Bullet points show how these activities could fit into journey and badge requirements, as well as which Community Action Projects have crossover.

What Color is Air Pollution?

This activity will demonstrate that air pollution spreads and doesn't stay where it is emitted and will show that air pollution from different sources mixes to make a new kind of air pollution (e.g., ground level ozone).

- Cadette Breathe Journey-Aware Award
    - Learn about air pollution issues
- Community Action Project: Create an Air Quality Campaign to educate your school or community about what you've learned. See Community Action Project document for more guidance.

Which Appliances Use the Most Energy?

In this activity, students will work in teams and use their reasoning skills to determine which common household appliances use the greatest amount of energy and in turn, contribute to the highest amount of air pollution.

- Junior Get Moving Journey-Energize Award
    - Can combine with "Energy We Use Every Day" in Journey guide
    - Energy Pledge in Journey: we have resources about how to be more efficient with energy usage in your home, and therefore reduce emissions (see Air Quality 101 on website)
- Community Action Project: Any of the "Engineering Ideas" incorporate building or assessing alternate energy sources and could pair well with the Innovate award. See Community Action Project document for specific projects.

Breathing Locally

This activity will allow students to consider how the transportation of food products can affect air quality. This lesson is best used in conjuncture with a lesson/discussion on the sources of air pollution and/or a lesson on locally produced food.

- Senior SOW What? Journey
    - Promote eating locally and all of its benefits, including a reduction in air pollution due to transporting food long distances
- *World Thinking Day Tradition* (February 22): Research countries environmental policies, how they impact air quality, etc.
- *New Cuisines*: Make a recipe created with all local ingredients from a farmers market, community garden, etc. to show possibilities when you buy local and discuss benefits in regards to air quality

Properties of Air

This activity allows scouts to explore the properties of air. At each station, scouts will be introduced to a different property of air and will participate in a hands-on activity that will allow them to see first - hand how air reacts to different changes in the environment.

- Breath Journey-Aware Award
    - Record observations and qualities of air in air log

Beyond These Activities…

- Junior Get Moving Journey: Transportation is one of the biggest sources of energy consumption. How can you encourage the school community to reduce energy use and emissions due to driving? Through Technology? By encouraging Green Driving Habits? These and more ideas are found in the Community Action project information.
- Cadette Breathe Journey: Air Pollution and transportation go hand in hand. How can you encourage the school community to reduce emissions due to driving? Introducing No-Idle Zones? Making sure school buses are well maintained? These and more ideas are found in the Community Action project information.
- Ambassador Eco Advocate: if you or girls in your troop are working towards their Ambassador Eco Advocate Badge, feel free to reach out and use us as a resource or partner!

1. What Color is Air Pollution?

Summary

This activity will demonstrate that air pollution spreads and doesn't stay where it is emitted and will show that air pollution from different sources mixes to make a new kind of air pollution (e.g., ground level ozone).

Time / Materials Needed

Time Considerations

15 – 20 minutes

Materials

- Package of white paper towels
- Package of 4 small bottles of food coloring (red, blue, yellow and green)
- Small, empty margarine tubs or small buckets (4 per station)
- Water
- Waterproof markers (Sharpie)
- Newspapers
- Scissors
- Clothesline
- Clip clothespins (1 per student)
- 12" green pipe cleaners (1 per student – for Extension Activity)
- Rubber bands (1 per student – for Extension Activity)

Background

Air pollution comes from many different sources, including industry, transportation, power plants, and gas stations. In most cities, road transportation sources such as cars, trucks, buses, and motorcycles contribute the most to air pollution. In our region, oil refineries, chemical manufacturing plants, plastic factories and power plants contribute more to air pollution than all other sources of air pollution combined. Vehicles emit a pollutant called Nitrogen Oxides, or NOx. This NOx then combines with Volatile Organic Compounds in the air (VOC's) and bakes together to form ground level ozone. Ground level ozone is harmful for plants as well as us if inhaled at a high concentration for long periods of time. It exacerbates asthma symptoms and can cause inflammation of lungs in healthy people if at a high concentration. In the summer we see higher levels of ozone pollution, so it is important to pay attention to the Air Quality Code in order to protect your health. If you have asthma or other respiratory complications and the forecast shows elevated levels of ground level ozone it is beneficial to perform outdoor activities in the morning or evening, instead of the heat of the day.

Other transportation sources that contribute to air pollution include trains, ships, planes, and construction equipment. These vehicles often run on diesel fuel and create a very harmful kind of air pollution called particle pollution. Gas stations, dry cleaners, and paint and body shops also contribute to air pollution and are known as area sources.

In this activity, students will think of different sources of air pollution and assign them a color. Food coloring will be used to tie-dye paper towels to show how air pollution moves and mixes, especially to form ground level ozone.

Getting Ready

1. Determine how many stations you will set up. If there is a large number of children, it may be necessary to create extra stations to prevent spills.

2. Prepare each station by covering a table with several layers of newspapers. Set out four large containers, each filled one-quarter full with water.

3. Add 10 drops of food coloring to the water in each tub. Use a different color for each tub, so that when you are finished, each station has tubs of red, blue, yellow and green.

4. Hang a clothesline outside. If it is necessary to hang the clothesline inside, then place newspapers underneath to catch dripping water.

Doing the Activity

1. Give each of the children a paper towel. Each child should write his or her name on a corner of the paper towel using a waterproof marker.

2. Show the children how to fold a paper towel into a small square (2" x 2"). You can do this by folding a paper towel in half, four times.

3. Ask the children to think about places where they have seen smoke. Discuss different sources of air pollution (see activity overview for examples). Ask the class to name four sources of air pollution, and assign each source to one of the tubs of colored water.

4. Have the children briefly dip one corner of their folded paper towels into a tub of colored water. Remind them of the pollution source for that color. Have them watch the "pollution" spread from the corner. Discuss with the children that air pollution doesn't stay where it comes out of the smokestack or tailpipe, either.

5. Repeat with the other paper towel corners in the other "pollution" colors.

6. Once all four corners have been dipped, have the children carefully unfold their paper towels on the newspaper-covered table.

7. Ask the children if they see any colors other than the four they used. Point out orange and purple and ask how they got those colors. Tell them that when air pollution from different sources mixes together (e.g., factories and gas stations), you can make a new kind of air pollution (e.g., ground-level ozone). Discuss ways they can help reduce emissions (carpool, walk/bike, turn off lights-anything that saved electricity reduces emissions).

8. Have the children carefully remove their dyed paper towels from the table and use clothespins to hang them on the line to dry.

Extension Activity

Once each paper towel is dry, it can be made into a flower or butterfly. Remind the students that flowers and butterflies need clean air to breathe, just like people do.

To make a flower:

1. Cut a tie-dyed paper towel into four squares (about 5" X 5").

2. Stack the squares on top of each other, staggering the corners of the squares.

3. Put the tip of your index finger in the middle of the stack.

4. Grab the stack from underneath with your other hand and wrap it around your index finger.

5. Twist the center of the paper towel squares and pull them off your finger.

6. Take the center of a green pipe cleaner and wrap it around the "base" of the flower.

7. Twist the rest of the pipe cleaner to make a stem.

8. Spread the squares apart and arrange them so they look like the petals of a flower.

To make a butterfly:

1. Lay the tie-dyed paper towel flat.

2. Gather the paper towel in loose folds from the top to the bottom.

3. Bend a pipe cleaner in half and put it around the middle of the gathered paper towel.

4. Twist the two halves of the pipe cleaner together at a place about 3" from the bend. This makes the body. Curl the two ends of the pipe cleaner to look like antenna. Straighten out the “wings.”

5. Attach a rubber band to the center of the body and “bounce” the butterfly to make it flutter.

Sources

OZONE Theater- http://mothersforcleanair.org/aqinfo/OZ_Activity_Guide.pdf

2. Which Appliances Use the Most Electricity?

Summary

In this activity, students will work in teams and use their reasoning skills to determine which common household appliances use the greatest amount of energy and in turn, contribute to the greatest amount of air pollution.

Time / Materials Needed

Time Considerations: 20 – 30 minutes

Materials:

Common Household Appliance Cards (included) ** Can be laminated for future uses**

Background

One way to reduce air pollution is to save energy, because most of the electricity produced in the United States involves the combustion of fossil fuels which produces particle pollution and emits Nitrogen Oxides, a main source of ground level ozone (contributes to smog). While homeowners might know what their average monthly electric or gas bill costs in dollars, they may not have a good idea of how many kilowatt-hours of electricity they use... or the amount of air pollution emissions that results from that use.

Individuals can choose to use less energy (turn off lights in unoccupied rooms), purchase more efficient equipment (a more efficient refrigerator or lights), make energy-efficient renovations (adding insulation or weather stripping) or use alternative energy sources (solar panels, air dry clothes, etc.).

Doing the Activity

Work with a partner or a group to rank these 18 appliances in order of how much electricity you estimate they use in one year. Rank the appliances *in order with the appliance that uses the most kWh per year first and the appliance that uses the least kWh per year last.*

Answer Key

Electricity Use Rank	Calculated Order List item with kWh/yr in parentheses
1	Water Heater (4,773)
2	Clothes Dryer (684)
3	Refrigerator with side– mounted freezer, through the door ice (630)
4	Refrigerator with top mounted freezer (383)
5	Television, 65-in plasma (346)
6	Dishwasher (270)
7	Clothes Washer (196)
8	Video Game system with Television (153)
9	Video Game on Desktop Computer (137)
10	Hair Dryer (98)
11	Television, 32-in LED (89)
12	Vacuum Cleaner (75)
13	Laptop Computer (71)
14	Lamp with a 60-watt incandescent bulb (66)
15	Microwave (49)
16	Coffee Maker (2 cup) (43)
17	Lamp with a 13– watt compact fluorescent bulb (14)
18	iPhone 6 (4)

CLOTHES DRYER

CLOTHES WASHER

COFFEE MAKER

DISHWASHER

HAIR DRYER

IPHONE 6

LAMP WITH A 60-WATT INCANDESCENT BULB

LAMP WITH A 13-WATT COMPACT FLUORESCENT BULB

LAPTOP COMPUTER

MICROWAVE

REFRIGERATOR

(with side-mounted freezer, and through the door ice maker)

REFRIGERATOR

(with top-mounted freezer)

TELEVISION

(32-inch LED)

TELEVISION

(65-inch Plasma)

VACUUM CLEANER

VIDEO GAME

(on desktop computer)

VIDEO GAME SYSTEM

(with LCD television)

WATER HEATER

3. Breathing Locally

Summary

This activity will allow students to consider how the transportation of food products can affect air quality. This lesson is best used in conjuncture with a lesson/discussion on the sources of air pollution and/or a lesson on locally produced food.

Time / Materials Needed

Time Considerations: 40 - 50 minutes

- White Poster Board (1 per group)
- Pencils/crayons/markers/colored pencils
- World Map (or online image of world map)
- Internet Access
- Calculator
- Working paper (for math portion)

Background

Food miles are the distance food travels from where it is grown to where it is ultimately purchased or consumed. Food miles—and the resulting pollution—increase substantially when we consider produce and goods imported from halfway around the world. In developed nations like ours, food is traveling farther to reach consumers and international food trade is increasing more rapidly than increases in population or food production. Today, the typical American prepared meal contains, on average, ingredients from at least five countries outside the United States.

Not only are the distances that food travels from farm to market important, but the modes of transport also have a large effect on how much pollution is generated. For example, importing food by airplane results in far greater emissions of greenhouse gases than imports by ship. In most cases, locally produced food proves the best choice for minimizing climate change and air pollutants. In fact, one study showed that when you combined all locally grown food in an area, it still produced less carbon dioxide emissions in transport than any one imported product to that same area. The effects that air pollution can have on our health influences high rates of asthma and other respiratory symptoms, as well as increased school absence days for children.

Getting Ready

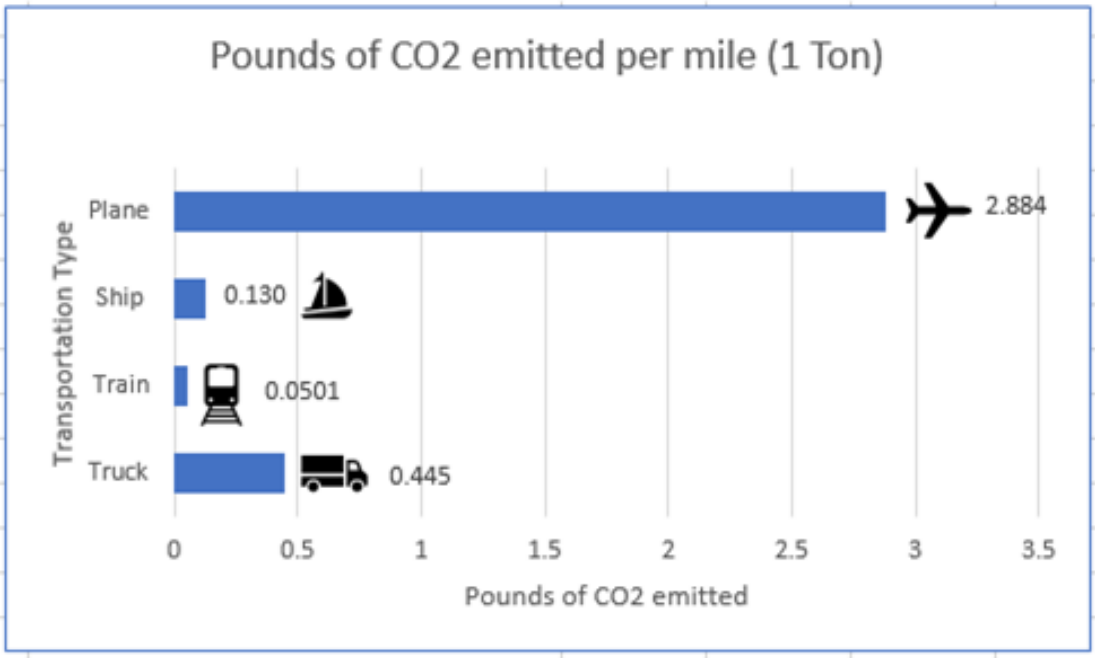
Start by discussing air quality, air pollutants, and their sources- particularly transportation. We have resources for this in our education materials on the NC DAQ website. Students should be separated into groups of 3 or 4 (ideally). Each group gets a piece of poster board paper and drawing materials.

Doing the Activity

1. Assign each group a location of varying distance from their home on the map.
    a. Example: Florida, Mexico, China, the next town/city over
2. Instruct students to create a diagram showing how the food will travel in order to get on their plates at home.
3. Have students (or a volunteer) look up how many miles it takes to get from their country/ location to their state (for out of state locations) or to their city (for in state locations).
4. Have students choose the vessel that their commodity would have to spend **THE MOST TIME** on to use for calculations.
5. Students will use information provided in the chart below to calculate the average number of pounds and/or grams of emissions are released in total to transport their commodity. *Remind them that this is the amount of emissions released to move only 1 ton of a product.*

Discussion Questions

- What is the best place to get your food in regard to air quality?
- What are some reasons why we typically get food from other states or countries?
- What are some other ways we can improve air quality?
- How do your emissions calculations compare to actual food transport, which carries many tons of product?



Sample Calculations

I used Japan as my country of origin. I googled 'Distance from Japan to North Carolina' and got 6,914 miles. My commodity would likely spend most of its time on a ship, so I will use that as my main vessel.

Here is my calculation:

(0.130 lbs/mi) x (6,914 miles) = 898.82 lbs CO_x/ ton

I multiplied the emissions per pound provided on graph by the number of miles traveled to get my answer. To bring food from Japan to North Carolina, a ship would release around 981.788 pounds of carbon for every ton it carries.

To put this into a real- life perspective, the average cargo ship will carry anywhere from 25,000 to 30,000 tons of cargo during each voyage.

(898.82 lbs/ ton) x (25,000 tons) = 22,470,500 lbs of carbon released in total

An average of twenty-two million, four hundred seventy thousand, five hundred pounds of carbon are emitted into the air from a typical cargo ship moving product from Japan to North Carolina.

Sources

Natural Resources Defense Council- https://food-hub.org/files/resources/Food%20Miles.pdf

Environmental Protection Agency-

https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

This activity has been created as a part of the N.C. Air Awareness internship program. If you have any feedback or suggestions of ways to improve this activity, please contact N.C. Awareness at air.awareness@ncdenr.gov.

4. Properties of Air

Summary

This activity allows scouts to explore the properties of air. At each station, scouts will be introduced to a different property of air and will participate in a hands-on activity that will allow them to see first - hand how air reacts to different changes in the environment

Time / Materials Needed

Time Considerations: 40 – 60 minutes

STATION 1: Can We Feel Air Pressure?

•One-quart or larger wide-mouth Mason jar or pickle jar (the mouth should be big enough to insert a large hand, yet small enough to cover with a dishwashing glove)

•Dishwashing glove (or nitrile glove)

STATION 2: How does Heating and Cooling Affect Air?

•Two empty glass bottles (e.g., wine bottle, Perrier bottle)

•Balloons to fit on the neck of the bottles

•Container of hot water, big enough to submerge bottom half of bottle

•Container of ice water, big enough to submerge bottom half of bottle

STATION 3: What Happens When Water Vapor in the Air Condenses?

•One-quart or larger wide-mouth jar

•Hot water from a faucet (or in an insulated pitcher or kettle)

•Small non-disposable plate (to fit over mouth of jar)

•Gallon freezer bag filled with ice cubes

STATION 4 (Optional): How Do Temperature, Volume, and Pressure Interact?

•Glass jar (large, wide-mouth mason jar)

•Water balloons, several, in case one breaks

•Several tea candles

•Matches

•Metal tongs to lower tea candle(s) into the jar (or use fireplace matches or lighter to light Candle after you've placed it in jar)

•Plastic tray or dishpan, optional

Station 1: Can We Feel Air Pressure?

Air may look like nothing, but it does take up space. **In other words, it has volume. Air also exerts pressure.**

1. Drape the glove into the jar, fingers down, and fold the cuff over the mouth of the jar. (If using a plastic bag instead of a glove, drape the bag into the jar, then use a rubber band to secure it to the rim of the jar, forming an air tight seal.)

2. Place your hand in the glove and attempt to push it in farther or pull it out. You will be able to push it in or pull it out a small amount, but after that your hand will meet serious resistance. Why? *[Answer: because the jar is already full of something – air!]*

3. What does it feel like when you first begin pushing your hand into the jar and how does the sensation change as you continue pushing? What property of air are you feeling on your hand? [Answer: you feel more and more pressure all over your hand; air pressure]

4. What happens when you try to pull the glove out of the jar? Why? *[Answer: the sides of the glove get sucked in; air pressure in the jar is getting very low as you increase volume; this creates suction on the glove]*

5. Why are you able to push the glove in or pull it out at all? Would you be able to do that if the jar were filled with water instead of air? Sand instead of air? *[Answer: Yes, it's possible to push the glove in and pull it out. No because air is compressible; water is only minimally compressible (not noticeable), sand is not.]*

6. Before moving to the next station, remove the glove from the jar.

Station 2: How does Heating and Cooling Affect Air?

Temperature changes are the primary drivers of air movement and weather in our atmosphere. See if you can explain how heating and cooling is affecting the air molecules in the balloons.

1. Place one bottle in a container of hot water, and the other in a container of ice water.

2. Place a balloon on the neck of each bottle.

3. Now take the bottle from the ice water and put it in hot water. What happens? Why? *[Answer: balloon expands because the air in the bottle is heated and expands into the balloon]*

4. Take the bottle that started out in the hot water and place it in the ice water. What happens to the balloon? Why? *[Answer: balloon deflates because air in the bottle gets cooler and contracts]*

5. Before moving to the next station, remove the bottles from the containers of water, and take off the balloons.

Station 3: What Happens When Water Vapor in the Air Condenses?

Air contains water vapor, which is the gaseous form of water. Cold air holds less water vapor than warm air.

1. Put about two inches of hot tap water in a jar.

2. Cover the mouth of the jar with a small plate.

3. Place the gallon bag of ice cubes on the plate.

4. You will need to wait a few minutes before finishing this demonstration – while you are waiting, do Part B of this station.

5. What do you see on the bottom of the plate? Why? *[Answer: condensation will form on the bottom of the plate and drip off. Water vapor in the air condenses on the cold plate, because cold air holds less water vapor than warm air.]*

6. Before moving to the next station, remove the plate from the jar. Take off the bag of ice and wipe off the bottom of the plate.

Station 4: How do Temperature, Volume, and Pressure Interact?

Properties of air are interrelated. When one property is changed, the others will change in predictable ways.

1. Light the tea candles(s) and carefully use the tongs to place the candle(s) in the bottom of the jar.

2. Place the water balloon on top of the jar.

3. Watch the balloon carefully and notice what happens.

4. Watch what happens while the candle is burning.

5. What happened to the balloon after the candle(s) went out? [Answer: balloon should be pushed into the jar, either partially or completely]

6. Use what you know about changes in air temperature and changes in air pressure to explain what you observed. [Answer: As the air in the jar heated up, it expanded and some escaped around the balloon. When the candles went out, the air in the jar cooled and the air pressure dropped. At that point, the air pressure on the outside of the jar and balloon was higher than the air pressure in the jar, with the result that the balloon was pushed into the jar.]