

WHIRLING, SWIRLING AIR POLLUTION

KEY OBJECTIVES

1. Students learn how daily activities contribute to air pollution.
2. Students use a simple model to investigate air pollution.

INTRODUCTION

In this activity students get a sense of the many ways in which daily activities use natural resources and contribute to air pollution.

GUIDING QUESTIONS

1. What is the air feel like if we stand on a beach, what is the air like if we are standing on top of a mountain, or in a forest? What is the air like if we are standing in a big city, near a factory? What is different in the air, where do these things come from? Are they a problem? why?

MATERIALS

- Clear gallon jar or small fish tank
- Water
- Red food coloring
- Green food coloring
- Blue food coloring
- Yellow food coloring
- A spoon or other implement to stir the water
- A copy of the story 24 Hours of Edgar's Air Pollution for each student available for download at:
https://scied.ucar.edu/sites/default/files/images/activity/edgar_pollution3.pdf

TASKS/PROCEDURE

1. Remind students that air pollution comes from many different sources. As a class, brainstorm a list of the sources of air pollution and then organize them into four categories: (1) gasoline burning vehicles and engines, (2) electricity from fossil fuels like coal, (3) activities that put particulate matter in the air like fires, and (4) products that release chemicals into the air.
2. Tell students that in this activity they will consider how many small sources of air pollution from one individual person can add up to a lot of pollution.
3. Tell students that in this activity the water in the glass jar will be a simple model of the atmosphere and that food coloring will be used to model air pollutants released into the atmosphere throughout the day:
 - RED food coloring represents pollution from burning gasoline.
 - GREEN food coloring represents pollution from burning coal for electricity
 - BLUE food coloring represents pollution from particulate matter in the air.
 - YELLOW food coloring represents pollution from products that release chemicals in the air.
4. Pass out the story 24 Hours of Edgar's Air Pollution and tell students that they are going to walk through a typical day in the life of a person to see the cumulative impact of all air pollution he adds to the atmosphere.

CONNECTION TO SDGS



TOPICS

AIR POLLUTION **CLIMATE CHANGE**

CROSS LINKS

None

KEYWORDS

Fossil Fuels **Coal** **Particulate Matter**

LEVEL

Secondary Level

RESOURCE TYPE

EXPERIMENT

INTENDED AUDIENCE SIZE

25 students, divided into groups of 5

MODE OF DELIVERY

Small Group

TIME FOR ACTIVITY

45 - 60 min.

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- Have each student read a part of the story (from one hour of Edgar's day and indicate what type of pollution should be added to the model. Add one drop of the appropriate colors of pollution for each hour. Have students take a closer look at the jar after 24 hours of Edgar's day. Ask students what colors they see in the jar. Consider what would happen to this air pollution if the air had been moving. Use a spoon to mix the air pollutants. Then ask students what colors they see in the jar.
- Lead a student discussion about how this model atmosphere is like, and unlike the real atmosphere. Ask students to consider how the food coloring is like and unlike air pollution. Have students consider how the model is useful. What does it show well? What does it not show? (Remind students that no model is entirely accurate. All models are representations of something else. This model represents the cumulative impact of air pollutants, but does not reflect how air moves in the atmosphere overall, the chemical changes that happen to air pollution in the air, or the relative amounts of air pollution from different hours of Edgar's day.)
- Assessment: Have students write their own versions of Edgar's day that would release less air pollution. Remind students that Edgar needs to do the same activities that he does in the story. Challenge students to write the story so that Edgar does activities in ways that release less air pollution. If time permits, have students research online whether products exist that do not release air pollutants (such as soap, shampoo, paint) and what types of technologies release less air pollution (like renewable energy sources, hybrid or natural gas vehicles).

FOSTERING DISCUSSION

Air pollution is a broad term that is applied to particulate matter and chemical compounds that are released by humans into the atmosphere and modify its composition. It was first perceived as a local problem in urban industrialized areas, so factories and power plants started building taller smoke-stacks. However, taller stacks merely transported the problem elsewhere and soon regional problems such as acid rain were recognized. In Scandinavia, for example, the acidification of lakes was found to be the result of sulfur dioxide emissions from tall stacks located in central European countries such as Germany and even in places as far off as Great Britain. More recently, global problems such as climate change and stratospheric ozone depletion have been widely publicized.

Natural sources that affect atmospheric chemistry include sulfur and nitrogen compounds from volcanoes and biological decay and particulate matter from dust storms and volcanoes. Plants, trees, and even grasses release volatile organic compounds (VOCs), such as methane, into the air. Of more concern, since we have the ability to control them, are anthropogenic (human-made) air pollutants, such as carbon monoxide, sulfur dioxide, some fraction of VOCs and nitrogen oxides. The largest source of anthropogenic pollution is the burning of fossil fuels, including coal, oil, and gas, in our homes, factories, and vehicles.

There are many forms of air pollution that are human-made. Industrial plants, combustion-fired power plants and vehicles with internal combustion engines generate nitrogen oxides, VOCs, carbon monoxide, carbon dioxide, sulfur dioxide and particulates. In many cities cars are the primary source of air pollutants. Stoves and incinerators, especially ones that are coal or wood-fired, and farmers burning their crop waste produce carbon monoxide, carbon dioxide, as well as particulates. Other human-made sources include aerosol sprays and gases leaking from refrigeration systems, as well as fumes from paint, varnish, and other solvents. Additional pollutants, like ozone and acids, are made in the atmosphere when human-made gases combine chemically.

Air pollution doesn't stay in one place. Winds and weather play an important part in transport of pollution locally, regionally, and even around the world.

POSSIBLE EXTENSIONS

Consider following this activity with a project in which students record their daily activities that cause air pollution and having students make one or two lifestyle changes that would decrease air pollution.

Some variations to consider - might the jar be hidden behind a piece of paper (or wrapped) while they add the drops as they go through their "audit".. and then reflect on what the result might look like BEFORE unveiling the jar.

it is even possible that the students could add - choose to add beneficial actions - things that would counter the effects -- plant trees, fit better technology to cars, factories etc -- This might be done by adding a little BLEACH to the jars - CARE NEEDS TO BE TAKEN as bleach should not be handled by young students, but might be added by a supervisor/facilitator during a discussion about WHAT WE CAN DO TO HELP.. The bleach will (over a few minutes) bleach the food dyes, making the colour lighter.. different food colours will bleach differently (you must check before hand) red and blue and green will often become colourless, or light yellow).

AUTHOR

Bibliotheca Alexandrina Planetarium Science Center