

## Design and Build an Air Pollution Collector

### Cross-cutting Concepts:

Scale, proportion, and quantity

Structure and Function

### Disciplinary Core Idea:

Earth and human activity

- ESS3.A 6-8: Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.
- **ESS3.C 6-8: Human activities have altered the biosphere, sometimes damaging it, although changes in environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.**

### Science and Engineering Practices:

Asking questions and defining problems (Grades 3-5 and 6-8)

Developing and using models (Grades 3-5 and 6-8)

Constructing explanations and designing solutions (Grades 6-8)

Obtaining, evaluating, and communicating information (Grades 3-5 and 6-8)

Opening questions:

- What is particulate matter?
- Where does it come from?
- How does it affect human health?

Particulate matter is a type of air pollution that can be created by natural processes and human activities. The most harmful particulate matter is composed of extremely small particles, liquid droplets, or aerosols measuring less than 2.5 microns in diameter. This type of pollution is often called "PM<sub>2.5</sub>" (pronounced "PM two point five").

Natural sources of particulate matter include:

- Volcanic eruptions
- Forest fires
- Dust storms

Human sources of particulate matter include:

- Combustion of fossil fuels
- Burning trash
- Cigarette smoking

Particulate matter is harmful to human health because it can be inhaled deep into lungs, where it can cause damage to lung tissue and may even cross into the bloodstream. Particulate matter affects all people, but certain groups are especially vulnerable to its health effects including:

- Children
- Elderly
- People with lung problems such as asthma, emphysema, and COPD
- People with heart problems

Because it is so small, particulate matter is invisible. How do we know if particulate matter is in the air?

### Students Generate Questions

Students should spend some time generating questions that will help them design a particulate matter collector. Examples of questions could include:

- How do I catch particulate matter?
- Should I design an active or passive collector?
  - o An active collector is one that uses a pump to actively pull air through it, while a passive collector relies only on natural air currents to carry pollutants onto or through it.
- How could I get air to move through my collector (if active)?
- Is my collector a prototype model or a working collector?
- Where would I place my collector?
- How will I measure what I collect?

### Students Design Solutions

Students work in teams to design a particulate matter collector that addresses the questions they generated.

### Students Construct Collectors

Students must now turn their design into either a prototype model or a real working collector, using simple materials provided by instructor. Materials can include:

- Various kinds of filter materials (coffee filters, white knee-hi stockings, tissue, scrubber sponges, cotton balls)
- Paper or plastic plates & cups
- Tape, glue
- Various kinds of clips
- Soda straws
- Chenille stems
- Brass fasteners
- Cardstock, index cards, small boxes
- Construction paper
- Plastic bottles (1- and 2-liter)
- Vaseline
- Scissors

### Share-a-thon

Students present their collectors to the class, highlighting how it works and how they would measure the results. How would they answer the questions they generated?

### Follow-up

How does a real particulate matter collector work? Students can research this question and explore how and where their state air quality agency monitors particulate matter and other pollutants.

## Resources

<https://landairwater.me/2017/05/26/students-design-air-quality-solutions/> Read an article about this activity and how it was used with a Frankfort homeschool group.

<https://eec.ky.gov/Environmental-Protection/Air/Air-Monitoring/Pages/default.aspx> -- This website describes how and where the Kentucky Division for Air Quality monitors for various pollutants across the Commonwealth.

<https://www.airnow.gov/index.cfm?action=student.main> – Students can learn about the effects of ozone and particle pollution. Play the "Smog City" simulator to see how individual choices, environmental factors and land use contribute to air pollution.

<https://www.epa.gov/sites/production/files/2015-08/documents/peg.pdf> -- The U.S. Environmental Protection Agency's *Plain English Guide to the Clean Air Act* offers a good introduction to how air pollution is regulated to protect public health and the environment.

<https://eec.ky.gov/Environmental-Protection/Air/Pages/Division-Reports.aspx> – The Division for Air Quality annual reports contain real air monitoring data from Kentucky's air monitoring network.

[https://airnow.gov/index.cfm?action=learning.workshop\\_for\\_teachers](https://airnow.gov/index.cfm?action=learning.workshop_for_teachers) – This is EPA's toolkit for K-12 teachers who want to help students gain a better understanding of air quality and air pollution issues, experience hands-on activities, and gain insights into topics such as global warming and climate change, calculating a carbon footprint, and the health effects of air pollution.

*Contact the Division for Air Quality for more information or to schedule a classroom visit to your school.*

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