



Extension Activity – Air

Title of Activity - The Air We Breathe

Concepts/Principles Covered –

According to the Environmental Protection Agency (EPA), particulates in the air are a mixture of solid particles and liquid droplets. Some, such as dust, dirt, soot, or smoke, are large enough to be seen with the eye (usually about 10 microns in size or larger). Others are so small they can only be seen using a microscope.

About 90% of the particles in the air are smaller than 10 microns. Particle pollution includes inhalable particles, 10 microns in diameter or smaller, as well as fine inhalable particles, with diameters of 2.5 microns (30 times smaller than the thickness of a human hair) or smaller.

These particles come in various shapes and are comprised of hundreds of different chemicals. Some are emitted directly from sources like fires, construction sites, or smokestacks. Most particles form as a result of complex chemical reactions due to the emission of sulfur dioxide and nitrogen oxides from power plants, industries and automobiles. Some particulate is visible as haze.

Inhalation of particulate can cause serious health problems. Those smaller than 10 microns in diameter can invade your lungs and even the bloodstream, with those smaller than 2.5 micron being of greater risk. The EPA regulates inhalable particles to maintain air quality standards in the U.S. The Air Quality Index (AQI) indicates the cleanliness of outdoor air and any associated health effects. Numerical data is translated into an AQI value and a corresponding color to help people understand when to take action to protect their health.

<https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>

Short Description –

Use engineering design and teamwork to design and fabricate an optimized particulate collector and process for assuring optimized collection methods and data reporting.

Standards Covered -

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.





MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

HS- ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity

HS- ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

HS- ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems

HS- ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Length - 2 hours as well as additional collection and evaluation time over multiple days. Allow additional time for research and re-iteration.

Age Group – Grades 7-10

Materials and Supplies -

- Index cards or cardstock/cardboard pieces, 3"x5" in size
- Wide, clear packing tape
- An 8" piece of string or yarn for each card
- Magnifying glass or microscope

Step by Step Instructions -

- Cut a 2" x 4" hole in each index card or cardstock. Label as "Pollution Monitor - Do Not Touch." Cover the opening with packing tape. Attach the string to the frame of the cardstock.
- Design iterations can include altering materials, size and shape of collector, identification of sites.
- Carefully hang the pollution detectors in a variety of places (near traffic, near air vents at school, near machinery). Leave the pollution detectors hanging for at least 24 hours.
- Make a 1" x 1" grid on a transparency sheet to overlay on the pollution detector to tally the number of particles per square inch, as identified with a magnifying glass or microscope.
- Describe and draw some of the magnified particles seen. Compare particulate to the ones here [:https://www.teachengineering.org/content/cub/_lessons/cub_air/cub_air_lesson02_pollutants.pdf](https://www.teachengineering.org/content/cub/_lessons/cub_air/cub_air_lesson02_pollutants.pdf)
- Compute the average number of particles on the pollution detector by adding the number of particles counted in each area and dividing by the number of areas evaluated.
- Compare the number of particles on each pollution detector with other pollution detectors to find areas with many particles in the air and areas with fewer particles in the air.
- Map or graph location versus pollution count and distribution.
- Have students make a graph of the amount of pollution in the air as a function of time of day.





- Based on your data:
 - What location indicates the highest particulate levels?
 - What time of the day is pollution highest? When is it lowest? What could cause the change in pollution levels?
 - What are the sources of the particulate identified? What impact does this have on the environment?
 - Research possible technical solutions to improve air quality

Modified from an activity at:

https://www.teachengineering.org/activities/view/cub_enveng_lesson07_activity1#:~:text=Search,the%20federal%20government.

