MODULE 3

Air Pollution in the Community

Combustion, Particulate Matter, and Community Health

Module Overview

Burning fuel, the chemical process of combustion, has been a part of human civilization since we first started using fire for warmth and cooking. When the Industrial Revolution provided us electricity through widespread use of coal-burning power plants, combustion brought all new benefits, and many serious drawbacks. The advent of cars and trucks driven by internal combustion engines multiplied these effects. Combustion produces particulate matter, a form of air pollution that can have very serious repercussions for human health and the environment. In this module, students will take on the role of concerned community members who fear that their proximity to sources of particulate matter, both from combustion and other processes, is endangering their health. Acting as citizen scientists, they will learn about where particulate matter comes from, and how it affects human health. They will also measure particulate matter in their community. The module culminates in a simulated public meeting before a state committee where students will take on different roles to argue whether or not diesel trucks should be banned from traveling through residential neighborhoods.

Anchor phenomenon: Streams of particulate matter emitted from diesel vehicles.

Pacing

- 9 activities (2 optional) + summative assessment
- Approximately 10 class periods (plus 2 optional)

When to Teach This Module

Finding the right place within a science scope and sequence to investigate air pollution with students can be tricky. Below you will find some information about the module that can help you decide where this it might fit into your own plans for student leaning:

- **Connection to Ecosystems**: Air pollution can have a tremendous effect on the health of ecoystems. The NGSS standards focus on how changes to a physical or biological component of an ecosystem can affect populations. In this module, the change in the ecoystem is particulate matter pollution, and the population affected is humans. Alignment to the standard would require additional examples of how other populations in the ecosystem is affected, but this module would fit well within a larger investigation of pollutants affecting ecosystems.

- **Connection to Human Health:** Air pollution from particulate matter pollution can have a significant impact human health. This module focuses specifically on how the health of a community is affected by particulate matter pollution. As such, it would fit well within a unit on the human respiratory and circulatory systems to add a real-world example of how the environment affects the health of human body systems.

- **Connection to Natural Resource Usage:** Air pollution is very much a story about human population and the consequences of how we use natural resources. While the module itself does not go into detail about kinds of natural resources, it would fit well as a part of a larger investigation of fossil fuels, and how our usage of those fuels affects human health.

Standards Overview

Middle School NGSS standards alignment

Performance Expectations

Focus PE:

MS-ESS3-3. Apply scientific principles to design a method for monitoring ~~and minimizing~~ a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

Background PEs:

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, ~~and on evaluating empirical evidence supporting arguments about changes to ecosystems~~.]

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

Science & Engineering Practices

Focus SEP: Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Background SEP: Analyzing Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Distinguish between causal and correlational relationships in data.

Background SEP: Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
- Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
- Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Disciplinary Core Ideas

Focus DCI: ESS3.C: Human Impacts on Earth Systems
Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)

Background DCI: LS2.A: Interdependent Relationships in Ecosystems
Organisms, and populations of organisms, are dependent on their environmental interactions ~~both with other living things and~~ with nonliving factors. Growth of organisms and population increases are limited by access to resources.

Background DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience
Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)

Background DCI: ETS1.B: Developing Possible Solutions
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.

Crosscutting Concepts

Focus CCC: Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- Cause and effect relationships may be used to predict phenomena in natural or designed systems.
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability

NGSS 5th Grade Standards alignment

Performance Expectations:

Focus SEP: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Background SEP: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

Science & Engineering Practices

Focus SEP: Engaging in argument from evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct and/or support an argument with evidence, data, and/or a model.
- Use data to evaluate claims about cause and effect.

Background SEP: Analyzing and interpreting data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.
When possible and feasible, digital tools should be used.

- Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.
- Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.

Background SEP: Constructing explanations (for science) and designing solutions (for engineering)
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.

Disciplinary Core Ideas

Focus DCI: ESS3.C: Human Impacts on Earth Systems
Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

Background DCI: ETS1.B: Developing Possible Solutions
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

Crosscutting Concepts

Focus CCC: Cause and Effect: Mechanism and Explanation
Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain new contexts.

- Events that occur together with regularity might or might not be a cause and effect relationship.

Virginia Standards of Learning (SOLs) alignment

Science & Engineering Practices	
5.1 (c)	Interpreting, analyzing, and evaluating data. The student will… • represent and analyze data using tables and graphs • organize simple data sets to reveal patterns that suggest relationships • use data to evaluate and refine design solutions
5.1 (d)	Constructing and critiquing conclusions and explanations. The student will… • construct and/or support arguments with evidence, data, and/or a model • generate and compare multiple solutions to problems based on how well they meet the criteria and constraints
6.1 (c)	Interpreting, analyzing, and evaluating data. The student will… • organize data sets to reveal patterns that suggest relationships • construct, analyze, and interpret graphical displays of data • use data to evaluate and refine design solutions
6.1 (d)	Constructing and critiquing conclusions and explanations. The student will… • construct scientific explanations based on valid and reliable evidence obtained from sources (including the students' own investigations) • generate and compare multiple solutions to problems based on how well they meet the criteria and constraints
Content Standards	
6th Grade 6.9	The student will investigate and understand that humans impact the environment and individuals can influence public policy decisions related to energy and the environment. Key ideas include: c) major health and safety issues are associated with air and water quality; e) preventive measures can protect land-use and reduce environmental hazards; and f) there are cost/benefit tradeoffs in conservation policies.
Earth Science ES.11	The student will investigate and understand that the atmosphere is a complex, dynamic system and is subject to long-and short-term variations. Key ideas include c) natural events and human actions may stress atmospheric regulation mechanisms; and d) human actions, including economic and policy decisions, affect the atmosphere.

Common Core State Standards alignment

Literacy Standards	
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
WHST.6-8.1	Write arguments focused on discipline-specific content.
WHST.6-8.1B	Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
Math Standards	
6.SP.B.5	Summarize numerical data sets in relation to their context

5E Module Flow

Activity 1 (Engage): The Trouble With Trucks
Timing: 45 minutes
Purpose: Introducing the anchor phenomenon
- ✓ Students will ask questions to clarify and define the phenomenon of point-source air pollution (truck exhaust)

Activity 2 (Explore): What Happens When Things Burn?
Timing: 2 class periods (90-120 minutes)
Purpose: Connecting the physical phenomenon of exhaust from trucks with the scientific concepts of combustion and particulate matter
- ✓ Students will know that particulate matter (PM) comes from combustion
- ✓ Students will have an intuitive and a cognitive understanding of what PM 10 and PM 2.5 are.

Activity 3a (Explore): Measuring Particulate Matter Using Technology
Timing: 2-3 class periods (90-120 minutes)
Purpose: Measuring particulate matter in and around the school to learn how to measure PM and to determine if there are any air quality issues in the local school community
- ✓ Students will be able to measure particulate matter using technology
- ✓ Students will be able to use their measurements to draw and support conclusions about how healthy the air is near the school

Activity 3b (Explore): Measuring Particulate Matter Using Engineering
Timing: 3-4 class periods
Purpose: Building particulate matter collectors to use around the school to develop engineering skills, learn how to measure PM, and to determine if there are any air quaity issues in the school community
- ✓ Students will be able to design, test, and deploy particulate matter collectors
- ✓ Students will be able to collect and analyze data to determine what areas of the school community have high levels of particulate matter in the air

Activity 4 (Explain): Particulate Matter and Human Health
Timing: 30-45 minutes
Purpose: Understanding how particulate matter affects human health at a physiological level
- Students will be able to identify the major health risks of particulate matter pollution
- Students will be able to compare and contrast the health effects of PM 2.5 and PM 10

Activity 5 (Elaborate): Particulate Matter in the Community
Timing: 45-60 minutes
Purpose: Understanding how particulate matter affects human health at the community level

- ✓ Students will analyze data in order to connect particulate matter pollution to health outcomes in a community
- ✓ Students will be able to distinguish between causation and correlation

Activity 6 (Elaborate): Air Toxics in the Community (optional)
Timing: 45 minutes
Purpose: Understanding hazardous air pollution and how it can affect communities

- Students will learn how scientists identify sources of toxic chemicals in the community
- Students will understand the difference between the criteria pollutants and toxic chemical pollutants

Activity 7 (Elaborate): Who is Polluting in My Neighborhood (optional)
Timing: 45-60 minutes
Purpose: Identifying potential sources of harmful air pollution in local neighborhoods

- Students will research air pollution sources in their communities and analyze their findings

Activity 8 (Elaborate): Not in My Backyard: Environmental Justice
Timing: 60 minutes
Purpose: Investigating environmental (in)justice using EPA's EJ Screen tool

- Students will understand the concept of environmental justice
- Students will investigate environmental justice in their community to see if certain groups of people are more frequently affected by air pollution

Activity 9 (Evaluate): Public Hearing on Banning Diesel Trucks in the Neighborhood
Timing: 2-3 class periods (120-180 minutes)
Purpose: Understanding the public policy of air quality, and learning to advocate for air quality issues

- Students will explore and learn different perspectives on public policy related to air quality
- Students will make arguments based on evidence about whether or not diesel trucks should be banned in the community

Module Materials

Activity 1 (Engage): The Trouble With Trucks

- ❒ Handouts: none
- ❒ Materials needed: Computer & projector, sticky notes, sentence strips
- ❒ Optional materials: Air Quality Champions interview (see end of module)

Activity 2 (Explore): What Happens When Things Burn?

- ❒ Handouts: What Happens when Things Burn? notes sheet
- ❒ Materials needed: Two candles (large and small) and lighter/matches, glass jar that you can put over the small candle (or a metal can with the label removed), flour, flashlight, orange/match
- ❒ Optional materials: aluminum foil, ice, paper

Activity 3a (Explore): Measuring Particulate Matter Using Technology

- ❒ Handouts: Measuring PM in the Classroom, Measuring PM in the School Community
- ❒ Materials needed: AirBeams (approx. 1:4 students; see module for details), Android device with AirCasting app, clipboards, computer & projector
- ❒ Optional materials: Student computers

Activity 3b (Explore): Measuring Particulate Matter Using Engineering

- ❒ Handouts: Design a Partculate Matter Detector
- ❒ Materials needed: Graph paper, magnifying glass/dissecting scope, materials for building and testing the PM detectors (see module for details), scissors, additional blank paper
- ❒ Optional materials: none

Activity 4 (Explain): Particulate Matter and Human Health

- ❒ Handouts: The Health Effects of Particulate Matter
- ❒ Materials needed: Sentence strips, computer & projector
- ❒ Optional materials: Student computers

Activity 5 (Elaborate): Particulate Matter in the Community

- ❒ Handouts: Citizen Science: How Particulate Matter Pollution Affects a Community
- ❒ Materials needed: Graph paper
- ❒ Optional materials: Student computers

Activity 6 (Elaborate): Air Toxics in the Community (optional)

- ❒ Handouts: Air Toxics in the Community, Air Toxics and Criteria Pollutants
- ❒ Materials needed: Computer & projector, speakers
- ❒ Optional materials: none

Activity 7 (Elaborate): Who is Polluting in My Neighborhood? (optional)

- ❒ Handouts: Air Pollution Sources in My Community
- ❒ Materials needed: Computer & projector
- ❒ Optional materials: Student computers (highly recommended)

Activity 8 (Elaborate): Not In My Backyard: Environmental Justice

- ❒ Handouts: Environmental Justice Investigation Guide
- ❒ Materials needed: Computer & projector, internet connection
- ❒ Optional materials: Student computers (highly recommended)

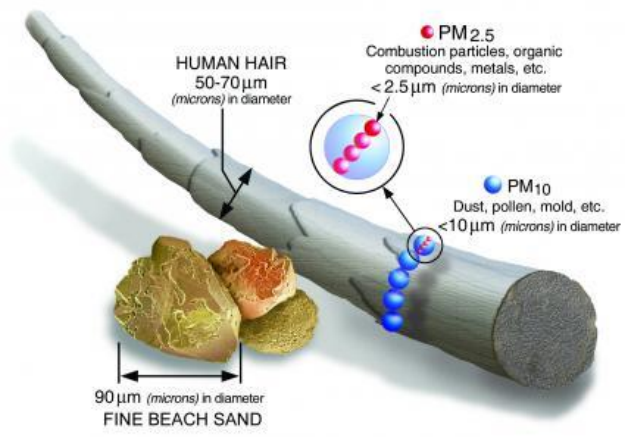
Activity 9 (Evaluate): Public Hearing on Banning Diesel Trucks in the Neighborhood

- ❒ Handouts: Role play stakeholder cards, Diesel truck ban role play scenario, Role play planning, hearing notes sheet, Cast Your Vote writing prompt
- ❒ Materials needed: Research materials (see module for details), presentation rubric (provided)
- ❒ Optional materials: Student computers, news article on California's diesel truck manufacturing phase-out

Teacher Background Information

Particulate Matter (PM) Basics

PM stands for particulate matter (also called particle pollution): the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.



Particle pollution includes:

- **PM_{10}** : inhalable particles, with diameters that are generally 10 micrometers and smaller; and
- **$PM_{2.5}$** : fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.
    - How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.

These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Most particles form in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides, which are pollutants emitted from power plants, industries and automobiles.

What are the Harmful Effects of PM?
Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Some particles less than 10 micrometers in diameter can get deep into your lungs and some may even get into your bloodstream. Of these, particles less than 2.5 micrometers in diameter, also known as fine particles or $PM_{2.5}$, pose the greatest risk to health.

Fine particles are also the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas.

What is Being Done to Reduce Particle Pollution?
EPA regulates inhalable particles. Particles of sand and large dust, which are larger than 10 micrometers, are not regulated by EPA. EPA's national and regional rules to reduce emissions of pollutants that form PM will help state and local governments meet the Agency's national air quality standards.

How Can I Reduce My Exposure to PM?
You can use air quality alerts to protect yourself and others when PM reaches harmful levels:

AirNow: Every day the Air Quality Index (AQI) tells you how clean or polluted your outdoor air is, along with associated health effects that may be of concern. The AQI translates air quality data into numbers and colors that help people understand when to take action to protect their health.

- Go to About AirNow to learn how you can get AQI notifications.
- Also learn how the Air Quality Flag Program can help air agencies, schools, and other community organizations to notify their citizens of harmful conditions and adjust outdoor physical activities as needed.

Source: Particulate Matter (PM) Pollution, US EPA. https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

Principles of Environmental Justice

Delegates to the First National People of Color Environmental Leadership Summit held on October 24-27, 1991, in Washington DC, drafted and adopted 17 principles of Environmental Justice. Since then, *The Principles* have served as a defining document for the growing grassroots movement for environmental justice.

WE, THE PEOPLE OF COLOR, gathered together at this multinational People of Color Environmental Leadership Summit, to begin to build a national and international movement of all peoples of color to fight the destruction and taking of our lands and communities, do hereby re-establish our spiritual interdependence to the sacredness of our Mother Earth; to respect and celebrate each of our cultures, languages and beliefs about the natural world and our roles in healing ourselves; to ensure environmental justice; to promote economic alternatives which would contribute to the development of environmentally safe livelihoods; and, to secure our political, economic and cultural liberation that has been denied for over 500 years of colonization and oppression, resulting in the poisoning of our communities and land and the genocide of our peoples, do affirm and adopt these Principles of Environmental Justice:

1) **Environmental Justice** affirms the sacredness of Mother Earth, ecological unity and the interdependence of all species, and the right to be free from ecological destruction.

2) **Environmental Justice** demands that public policy be based on mutual respect and justice for all peoples, free from any form of discrimination or bias.

3) **Environmental Justice** mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things.

4) **Environmental Justice** calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and poisons and nuclear testing that threaten the fundamental right to clean air, land, water, and food.

5) **Environmental Justice** affirms the fundamental right to political, economic, cultural and environmental self-determination of all peoples.

6) **Environmental Justice** demands the cessation of the production of all toxins, hazardous wastes, and radioactive materials, and that all past and current producers be held strictly accountable to the people for detoxification and the containment at the point of production.

7) **Environmental Justice** demands the right to participate as equal partners at every level of decision-making, including needs assessment, planning, implementation, enforcement and evaluation.

8) **Environmental Justice** affirms the right of all workers to a safe and healthy work environment without being forced to choose between an unsafe livelihood and unemployment. It also affirms the right of those who work at home to be free from environmental hazards.

9) **Environmental Justice** protects the right of victims of environmental injustice to receive full compensation and reparations for damages as well as quality health care.

10) **Environmental Justice** considers governmental acts of environmental injustice a violation of international law, the Universal Declaration On Human Rights, and the United Nations Convention on Genocide.

11) **Environmental Justice** must recognize a special legal and natural relationship of Native Peoples to the U.S. government through treaties, agreements, compacts, and covenants affirming sovereignty and self-determination.

12) **Environmental Justice** affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all our communities, and provided fair access for all to the full range of resources.

13) **Environmental Justice** calls for the strict enforcement of principles of informed consent, and a halt to the testing of experimental reproductive and medical procedures and vaccinations on people of color.

14) **Environmental Justice** opposes the destructive operations of multi-national corporations.

15) **Environmental Justice** opposes military occupation, repression and exploitation of lands, peoples and cultures, and other life forms.

16) **Environmental Justice** calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives.

17) **Environmental Justice** requires that we, as individuals, make personal and consumer choices to consume as little of Mother Earth's resources and to produce as little waste as possible; and make the conscious decision to challenge and reprioritize our lifestyles to ensure the health of the natural world for present and future generations.

A pdf version of these principles can be found here: https://www.ejnet.org/ej/principles.pdf

Additional Information about Environmental Justice

- EPA Tools to Support Environmental Justice: https://www.epa.gov/healthresearch/tools-support-environmental-justice
- EPA: How to Interpret a Standard Report in EJ Screen: https://www.epa.gov/ejscreen/how-interpret-standard-report-ejscreen

Doing Our Part

- Find ways to use less electricity: turn off electronics when you're not using them like TVs and game consoles. Turn off the lights when you leave a room or when you leave the house.

- Buy local products that were made in the United States so there is less transportation. This is especially true of food. Food that is "in season" can usually be grown from nearby states so there is less transportation involved.

- Talk to your school leaders about creating an idle-free zone at the bus and car drop off. This means that cars and buses must turn off their engines when they stop to pick up and drop off students.

- Look up anti-idling campaigns in your area of other ideas on how to prevent particulate matter pollution from idling vehicles. For example, check out Idle Free Maryland: https://mde.maryland.gov/programs/Air/MobileSources/idlefreeMD/Pages/index.aspx

- Look up the local particulate matter air quality (AQI) using a computer or install an air quality app on your phone or your parents' phone. Use the AQI so you know when and how to avoid air pollution, especially on bad days.

- Avoid places where you know the air quality is likely to be bad, such as near roadways with lots of traffic (especially big trucks) or near power, cement, and chemical plants that are in your neighborhood. When walking to school, choose a route that stays away from busy streets.

- If you sometimes have difficulty breathing, talk to your parent(s) or doctor so they can make sure you get the help you need.

About this section

This section in included in every module either as a list or as part of an activity. It describes actions students can take to mitigate the effects of air pollution in their lives, and to help prevent air pollution from getting into the atmosphere. Many of these suggestions are the same from module to module, but there are variations depending on the focus of the module.

While the actions from this section are not explicitly built into the curriculum, they can be used in various ways to motivate students and provide them opportunities to take action to make a difference in their community. For more information, see the "Doing Our Part" section in "How to Use this Curriculum"

Air Quality Champion in Our Community

Name: Joshua Shodeinde
Title: Regulatory and Compliance Engineer
Organization: Maryland Department of the Environment

How does your work relate to air quality?
I work in the Air Regulations Development Division at the Maryland Department of the Environment (MDE). MDE's mission is to protect and restore the environment for the health and well-being of all Marylanders. I work with a team of engineers who write air regulations (rules) that air pollution sources such as power plants or manufacturing facilities have to follow. These rules help to ensure that the air we breathe in Maryland is healthy and safe.

What is your workday like?
My daily tasks vary from day-to-day. One day I may share ideas with other regulators on rules to reduce pollution, on another day I may meet with businesses to help them understand a regulation. Sometimes, I read and learn about sources of air pollution and what needs to happen to improve air quality. I really enjoy the variety of my job.

What motivates you to come to work every day?
My biggest motivation is knowing that my work is directly involved with improving air quality. I used to have asthma growing up, so working in a field where I can help reduce toxic air pollutants and potentially reduce asthma attacks has a personal connection to me. I also have a young daughter who I want to grow up strong and healthy. I want her to have a love for nature and outdoor activities like taking walks or biking or hiking. Working to protect Maryland's air quality will allow my family and millions of others in the state to enjoy the great outdoors without worry.

What education and career path did you pursue to have the position that you have today?
I graduated college with a Bachelor of Science degree in Chemical Engineering. My first real job was working at a nonprofit organization, whose mission is to strengthen Baltimore's communities through education, skills development, and community service. This job taught me the importance of environmental and energy stewardship, a fancy way of saying that we should all act responsibly to protect Maryland's air, land, water, and energy. We can do this by turning off lights when we don't need them; riding our bikes and using public transportation whenever possible; not wasting water and food; and recycling. My role was to educate Baltimore residents about energy conservation and provide them with energy-saving items. Next, I worked at a company that helps business owners to upgrade their lighting to energy-efficient lights. Then I came to work at MDE.

What is your workspace like?
I work in an office cubicle, which has a table, file cabinets, and a desktop computer. I have pictures of my wife, daughter, and former colleagues in my cube. I enjoy going on walks with colleagues during break time (there's a park right beside our building) or talking about shows in the break room.

What accomplishment are you most proud of?
For work, I would say my biggest accomplishment has been writing two regulations which aim to reduce greenhouse gas emissions. It was a lot of work that required coordination with other staff at MDE, businesses, environmental advocacy groups, and concerned citizens. I remember the day I had to give a 3-hour presentation, with a question and answer session, on why these greenhouse gas regulations are important. With the help of my bosses and colleagues, we received support from everyone to move ahead with the regulations.

For my personal life, it is raising a 2-year-old. Kids are also lot of work! But I love her dearly and seeing her grow is so rewarding.

Is there something important that you want to share that we haven't asked?
I would just add that you don't need to work for an environmental agency to fight against air pollution and fight for improving air quality. Every day there is opportunity to play our role to help protect, preserve, and restore the environment. Play your part!

Glossary

air toxics - pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. Also known as toxic air pollutants or hazardous air pollutants

AQI (Air Quality Index) – a scale for reporting daily air quality. The AQI tells you how clean or polluted the air is in a given location, and what the associated health risks are. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air.

arsenic – an element that occurs naturally in Earth's crust, and is commonly found in water, air, and soil. In high enough quantities or in the case of long-term exposure, arsenic can cause significant health problems

cadmium – an element that occurs naturally in Earth's crust. Cadmium can be released to the air as a result of industrial processes. Inhaling cadmium fumes can be highly hazardous to health.

cardiovascular disease – a health condition that involves narrowed or blocked blood vessels that can lead to a heart attack, chest pain, or stroke.

combustion – the chemical process of burning. Combustion requires a fuel that is burned using oxygen in a chemical reaction that produces carbon dioxide and water. See also incomplete combustion

COPD (chronic obstructive pulmonary disease) - a group of related diseases that cause airflow blockage and breathing-related problems. COPD includes emphysema and chronic bronchitis.

diesel – a type of fuel made from oil that is used in specialized combustion engines (diesel engines) where it is ignited through compression as opposed to a spark in more common combustion engines

environmental justice – the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, or any other personal characteristic with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

incomplete combustion – a type of combustion that takes place when the supply of oxygen is poor. This results in a higher proportion of carbon monoxide gas and solid carbon (soot) being produced instead of carbon dioxide. Water is still a product of incomplete combustion.

lung function – a term used to describe how well the lungs work in helping a person breathe. Lungs function is measured by lung size, air flow, and other aspects of lung health.

micrometer/micron (symbol: μ) – a unit of length equal to one-millionth of a meter (0.000001 m). Micrometer is the SI unit of measure, while micron is the former name of the unit which is still in common use.

ozone (O_3) – a natural and a man-made gas made of three oxygen atoms that occurs in the Earth's upper atmosphere (the stratosphere) and lower atmosphere (the troposphere). Depending on where it is in the atmosphere, ozone affects life on Earth in either good or bad ways.

particulate matter (abbreviation: PM) **–** a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Larger particles are called PM 10, smaller particles are called PM 2.5, based on their diameter in micrometers.

soot – a black powdery or flaky substance consisting largely of amorphous carbon, produced by the incomplete burning of organic matter including fossil fuels.