

How Fair Is Your Air?

Materials:

- Container with one bag each of red beans, white (navy) beans, black beans and split peas
- Several tablespoon (or rough equivalent) measures
- One copy of the information sheet and AQI for ozone, particle pollution, carbon monoxide, sulfur dioxide, displayed in an acrylic bi-fold or glued to foam board and taped together in a bi-fold, so that it can stand up on the table.
- Several copies of the Air Quality Index Graph (enough for pairs of students or individual students to take a sample simultaneously on the table or ground nearby)

Engage: Ask students, What happens every time we take a breath? (students will likely respond that air goes into their lungs). We need air to live, but what exactly is air? It's a combination of gases and other molecules. The most common gases found in air are nitrogen (78%) and oxygen (about 21%), which are colorless and odorless (do not smell). There are other types of air molecules as well, but in very small quantities. Sometimes these molecules can cause health problems when we breathe them in and we can't see them or smell them, so scientists regularly test our air and let us know when we need to be careful outdoors and our health might be at risk. The Environmental Protection Agency (EPA) has stations set up all over the country that regularly check the air we're breathing and they have a system for letting us know when the air might cause health problems—they communicate that information to us using the AIR QUALITY INDEX.

Explore/Explain:

Tell students they are going to become Air Quality Testers for EPA by taking some air samples and analyzing those samples. Depending on how many students you have, have students work in pairs or individually—provide them with an Air Quality Data Sheet and instruct them to take their air quality sample by scooping out a tablespoon of the mixed beans. Then students should place one bean in the appropriate column starting from the bottom. When they've placed all their beans on their graph, they can analyze their data by looking at the corresponding Air Quality Index Reading (for instance, 5 beans would be an AQI of 100) and looking at corresponding AQ information sheet to see what the level meant and reading/discussing the following:

1. What was your overall AQI for each of the four air pollutants?
2. Are there any pollutants that are above safe ranges?
3. The EPA issues the "color" for the day based on the highest AQI—what color day would you issue based on your sample? (green, yellow, orange, red, purple, maroon)
4. What do you think might be some of the potential causes of decreased air quality? How do you think a community could reduce the problems?
5. What do you think are the potential health risks for people in your community with the AQI you found in your sample?

OZONE

(Green Peas)

What Is Ozone?

Ozone is a gas composed of three oxygen atoms.

Good Ozone is found naturally in the earth's atmosphere, 6-30 miles from the surface and forms a protective layer, called the ozone layer, which helps to protect us from the sun.

Bad Ozone is found closer to the surface of the earth near the ground and is formed when pollutants react with the sun. These pollutants come from:

- Cars
- Industry such as power plants, industrial production, chemical production and plants that refine oil for use as gasoline and other products

Health Risks:

Unhealthy levels of ground-level ozone can:

- Irritate the respiratory system, causing coughing, throat irritation, and/or an uncomfortable sensation in the chest.
- Reduce lung function and make it more difficult to breathe deeply and vigorously. Breathing may become more rapid and shallow than normal.
- Aggravate asthma. When ozone levels are high, more people with asthma have attacks that require a doctor's attention or use of medication.
- Increase respiratory infections.
- Inflammate and damage the lining of the lungs.

Air Quality Index (AQI): Ozone

Index Values	Levels of Health Concern	Cautionary Statements
0-50	Good	None
51-100*	Moderate	Unusually sensitive people should consider reducing prolonged or heavy exertion outdoors.
101-150	Unhealthy for Sensitive Groups	Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors.
151-200	Unhealthy	Active children and adults, and people with lung disease, such as asthma, should avoid prolonged or heavy exertion outdoors. Everyone else, especially children, should reduce prolonged or heavy exertion outdoors.
201-300	Very Unhealthy	Active children and adults, and people with lung disease, such as asthma, should avoid all outdoor exertion. Everyone else, especially children, should avoid prolonged or heavy exertion outdoors.
301-500	Hazardous	Everyone should avoid all physical activity outdoors.

PARTICLE POLLUTION

(Black Beans)

What is Particle Pollution?

Particle pollution is a mixture of solids and liquid droplets.

Fine particles-Particles less than 2.5 micrometers in diameter are called "fine" particles. These particles are so small they can be detected only with a special microscope. Sources of fine particles include all types of combustion (burning), including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

Coarse dust particles-Particles between 2.5 and 10 micrometers in diameter are referred to as "coarse." Sources of coarse particles include crushing or grinding operations, and dust stirred up by vehicles traveling on roads.

Health Risks:

- People with heart or lung diseases are more likely to visit emergency rooms, be admitted to hospitals or in some cases, even die. When exposed to particle pollution, people with heart disease may experience chest pain, palpitations, shortness of breath, and fatigue.
- When exposed to particles, people with existing lung disease may experience symptoms such as coughing and shortness of breath. Healthy people also may experience these effects, although they are unlikely to experience more serious effects.
- Particle pollution also can increase respiratory infections and for people with asthma and chronic bronchitis, can cause more use of medication and more doctor visits.

Air Quality Index (AQI): Particle Pollution

Index Values	Levels of Health Concern	Cautionary Statements
0-50	Good	None
51-100*	Moderate	Unusually sensitive people should consider reducing prolonged or heavy exertion.
101-150	Unhealthy for Sensitive Groups	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
151-200	Unhealthy	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
201-300	Very Unhealthy	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.
301-500	Hazardous	People with heart or lung disease, older adults, and children should remain indoors and keep activity levels low. Everyone else should avoid all physical activity outdoors.

CARBON MONOXIDE

(White Beans)

What is Carbon Monoxide?

Carbon monoxide is an odorless, colorless gas that is formed when the carbon in fuels doesn't completely burn. Exhaust from cars and other vehicles causes most of the carbon monoxide pollution, but it is also created by some industry and wildfires. Carbon monoxide is most likely to be a problem in colder weather, when incomplete burning is more likely to happen.

Health Risks:

When you breathe in carbon monoxide, it combines with hemoglobin, which is what carries oxygen to your cells and reduces the amount of oxygen that gets to your body's cells.

- People with cardiovascular disease (disease of heart and blood vessels), are most at risk. They may experience chest pain and other symptoms if they are exposed to carbon monoxide, particularly while exercising.
- In healthy individuals, exposure to higher levels of carbon monoxide can affect mental alertness and vision.

NOTE: Higher levels of carbon monoxide **inside** buildings and homes can be extremely dangerous and can cause death.

Air Quality Index (AQI): Carbon Monoxide (CO)

Index Values	Levels of Health Concern	Cautionary Statements
0-50	Good	None
51-100*	Moderate	None
101-150	Unhealthy for Sensitive Groups	People with heart disease, such as angina, should reduce heavy exertion and avoid sources of CO, such as heavy traffic.
151-200	Unhealthy	People with heart disease, such as angina, should reduce moderate exertion and avoid sources of CO, such as heavy traffic.
201-300	Very Unhealthy	People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.
301-500	Hazardous	People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic. Everyone else should reduce heavy exertion.

SULFUR DIOXIDE

(Red Beans)

What is sulfur dioxide?

Sulfur dioxide (SO₂), a colorless, reactive gas, is produced when sulfur-containing fuels such as coal and oil are burned. Major sources include power plants and industrial boilers. Generally, the highest levels of sulfur dioxide are near large industrial complexes.

Health Risks:

Sulfur dioxide is an irritant gas that is removed by the nasal passages. Moderate activity levels that trigger mouth breathing, such as a brisk walk, are needed for sulfur dioxide to cause health effects.

- People with asthma who are physically active outdoors are most at risk from sulfur dioxide. The main effect, even with brief exposure, is a narrowing of the airways (called bronchoconstriction). This may cause wheezing, chest tightness, and shortness of breath. Symptoms increase as sulfur dioxide levels and/or breathing rates increase. When exposure to sulfur dioxide ceases, lung function typically returns to normal within an hour.
- At very high levels, sulfur dioxide may cause wheezing, chest tightness, and shortness of breath even in healthy people who do not have asthma.
- Long-term exposure to sulfur dioxide can cause respiratory illness and can change the lungs' abilities to fight off illness.

Air Quality Index (AQI): Sulfur Dioxide (SO₂)

Index Values	Levels of Health Concern	Cautionary Statements
0-50	Good	None
51-100*	Moderate	None
101-150	Unhealthy for Sensitive Groups	People with asthma should consider reducing exertion outdoors.
151-200	Unhealthy	Children, asthmatics, and people with heart or lung disease should reduce exertion outdoors.
201-300	Very Unhealthy	Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion. Everyone else should reduce exertion outdoors.
301-500	Hazardous	Children, asthmatics, and people with heart or lung disease should remain indoors. Everyone else should avoid exertion outdoors.

Air Quality Index

500				
480				
440				
420				
400				
380				
360				
340				
320				
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280				
260				
240				
220				
200				
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160				
140				
120				
100				
80				
60				
40				
20				
Air Quality Index	Ozone (Green Peas)	Particle Pollution (Black Beans)	Carbon Monoxide (White Beans)	Sulfur Dioxide (Red Beans)

Evaluate: Have students work in groups to develop a presentation on the their “community” air quality findings which includes an overview of the findings from the “sample” data as well as an evaluation of the finding and recommendations to improve air quality in their “sample communities.”

Or have students locate Kansas quality reports from <http://www.airnow.gov/> by searching for the Kansas at the top of the page. Then ask students to review the AQ maps for the region for 2010 and 2011, noting air quality issues, locations, dates and patterns. (maps may be found at: <http://www.airnow.gov/index.cfm?action=airnow.mapsarchivecalendar> and select “Kansas/Nebraska” map. Based on data analysis, have students develop a presentation on Kansas Air Quality which includes their analysis of the region’s air quality data, identification of any potential patterns and recommendations for improving air quality in the region.