WHAT IS IN OUR AIR?

Teacher Companion Slides
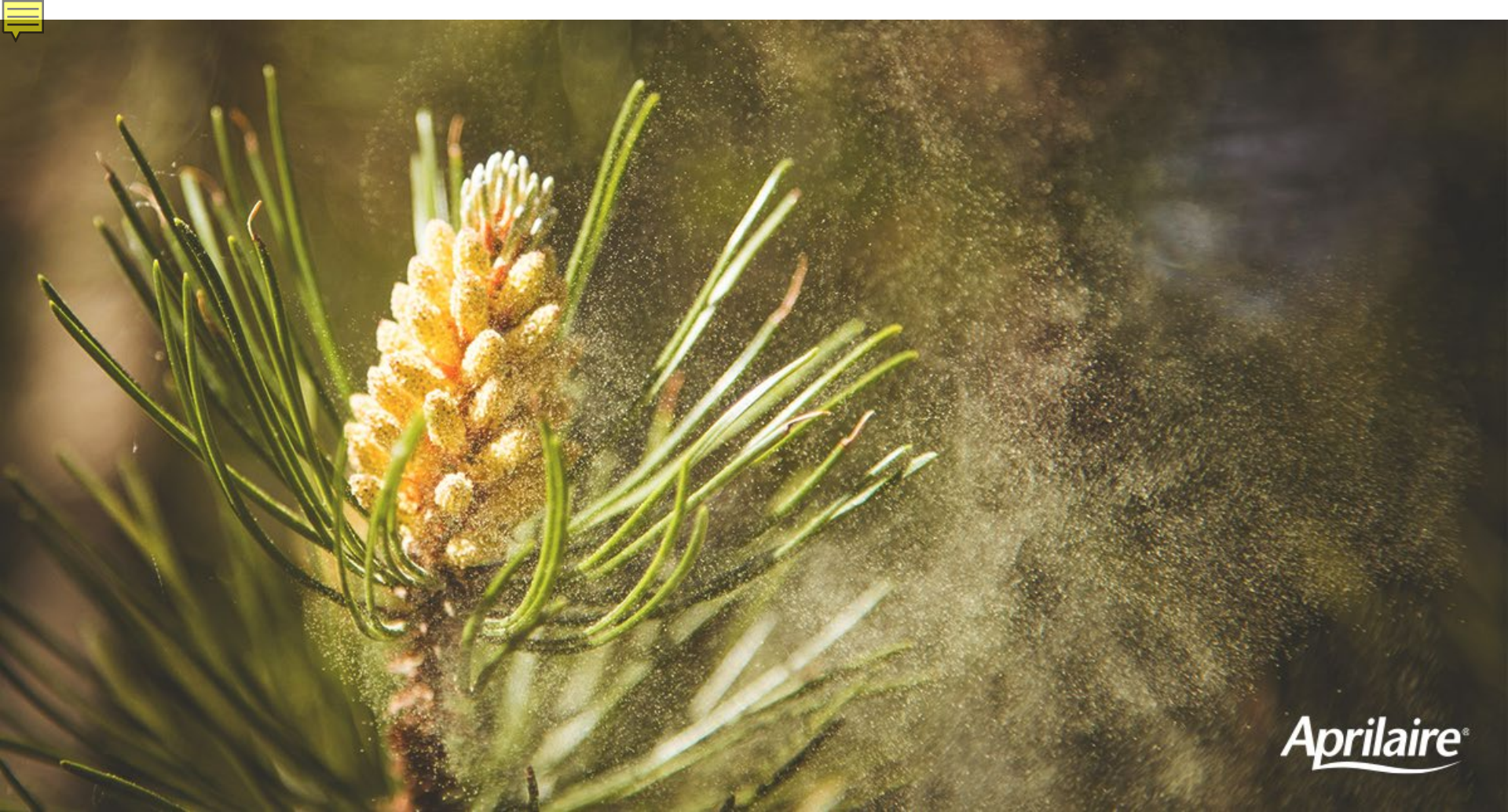
CARTEEH

MEASURING AIR POLLUTION

Conduct an investigation on air pollution

What is in our air?

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СС 067 70 RUS
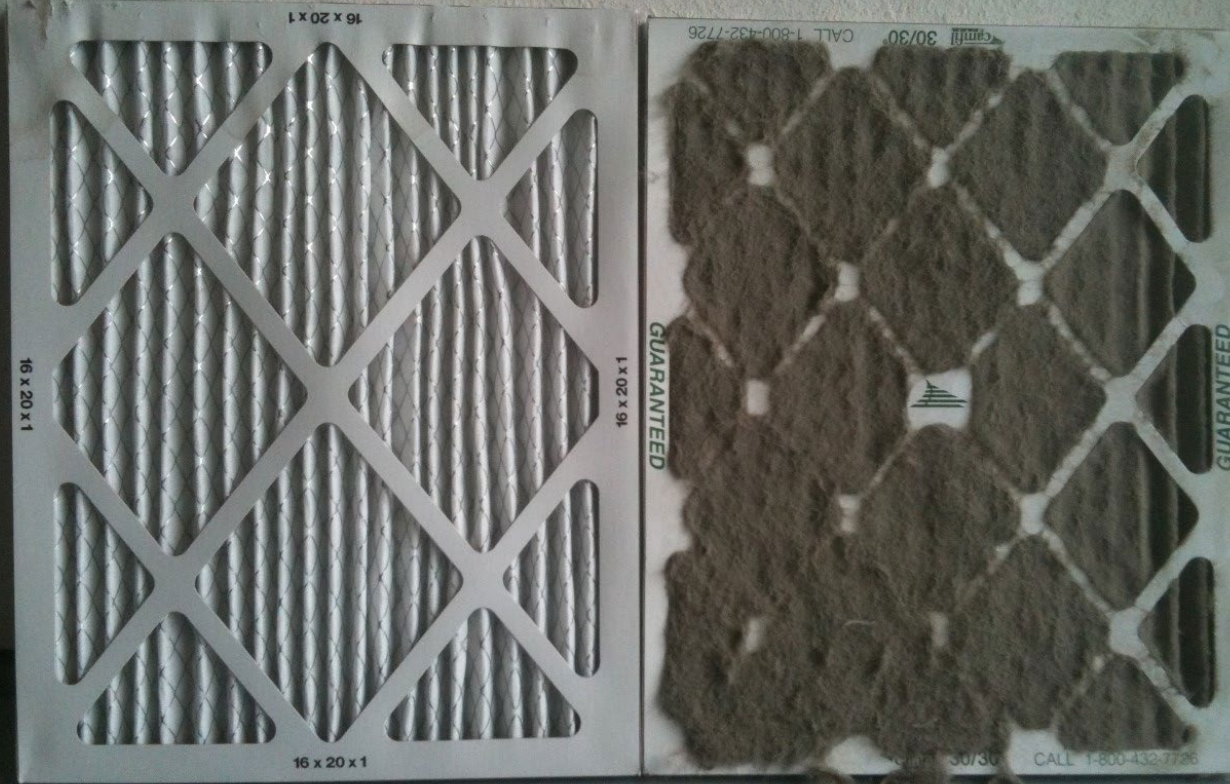
What is all this stuff traveling in the air?

How do people keep the air in their homes and schools clean from all these particles?

Where is all this stuff coming from?
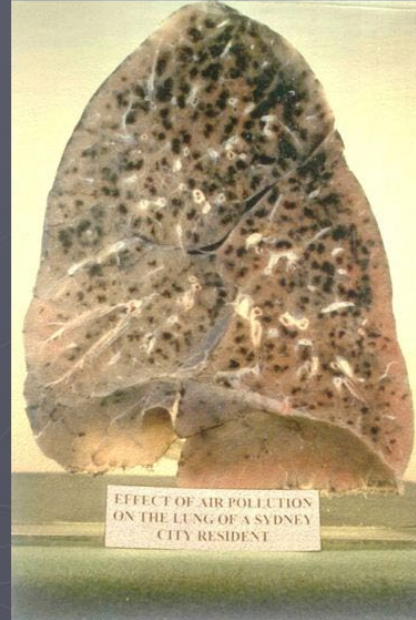
How does air become dirty?

Why should we care about dirty air?

How does pollution impact our lungs?

How does pollution impact our lungs?

Coughing

Shortness of breath

Reduced lung function

Lung cancer

Global Impact

1 out of 8 deaths in the world is due to poor air quality

This is one of the largest public health threats of our time.

How can we compare the air in two different places?

Changes in air over time?

HUMAN HAIR
50-70 μm
(microns) in diameter

PM2.5
Combustion particles, organic
compounds, metals, etc.
< 2.5 μm (microns) in diameter

PM10
Dust, pollen, mold, etc.
<10 μm (microns) in diameter

90 μm (microns) in diameter
FINE BEACH SAND
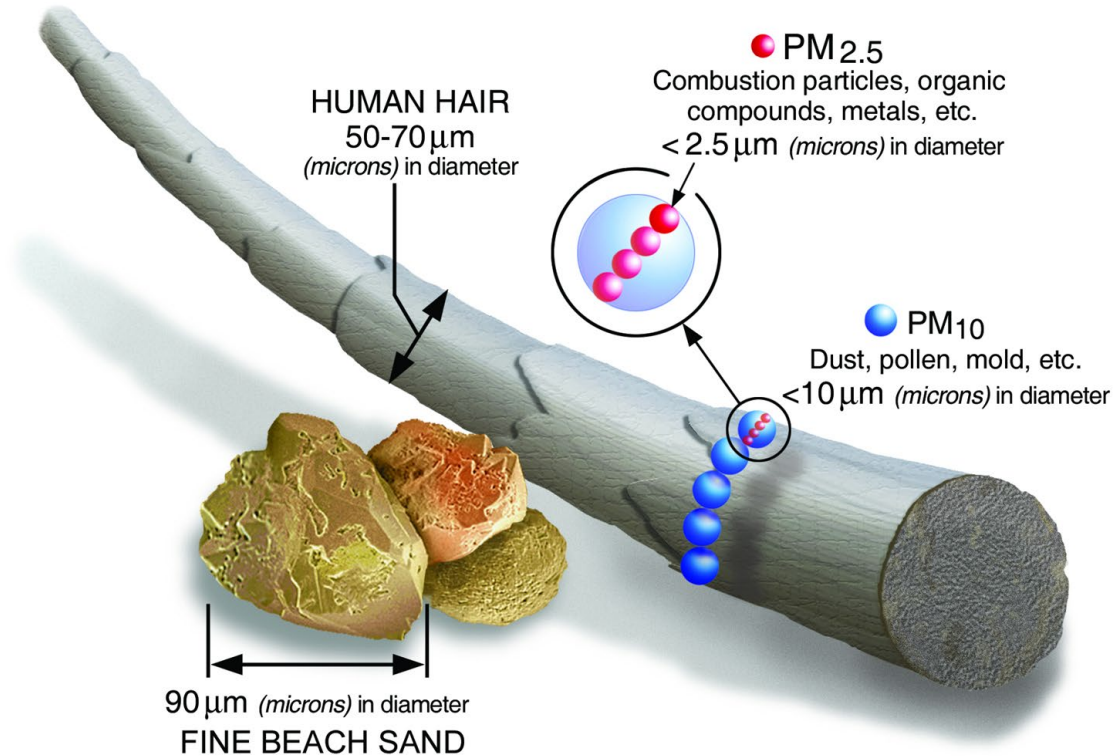
Particles in the Air

Hair (~50 microns):   pool noodle

Dust and pollen (~10 microns):   golf ball

Combustion particles like exhaust (~2.5 microns): grain of sand

IQ Air Monitor

Air Quality Scale

US AQI Level		PM2.5 (µg/m³)	Health Recommendation (for 24 hour exposure)
Good	0-50	0-12.0	Air quality is satisfactory and poses little or no risk.
Moderate	51-100	12.1-35.4	Sensitive individuals should avoid outdoor activity as they may experience respiratory symptoms.
Unhealthy for Sensitive Groups	101-150	35.5-55.4	General public and sensitive individuals in particular are at risk to experience irritation and respiratory problems.
Unhealthy	151-200	55.5-150.4	Increased likelihood of adverse effects and aggravation to the heart and lungs among general public.
Very Unhealthy	201-300	150.5-250.4	General public will be noticeably affected. Sensitive groups should restrict outdoor activities.
Hazardous	301+	250.5+	General public at high risk of experiencing strong irritations and adverse health effects. Should avoid outdoor activities.

PM2.5	Air Quality Index
0 to 12.0	Good 0 to 50
12.1 to 35.4	Moderate 51 to 100
35.5 to 55.4	Unhealthy for Sensitive Groups 101 to 150
55.5 to 150.4	Unhealthy 151 to 200
150.5 to 250.4	Very Unhealthy 201 to 300
250.5 to 500.4	Hazardous 301 to 500

What is the air like around our school?

<Add photo of your school>

1. Where do you want to take measurements? Why?
2. What data do you want to collect?
3. How can we organize that data?

Smog in a Jar

Some Things We know about Air

- We need air (and specifically the oxygen in it) to live and stay healthy.

- Different things (both large and tiny) can float in the air.
  - Pollen and Dust (which are larger)
  - Smog and Smoke (which are very tiny)

- Some of these particles come from natural things like flowers, while other particles come from human activities like burning gas in cars.

- We have a tool to measure the number of particles in the air.

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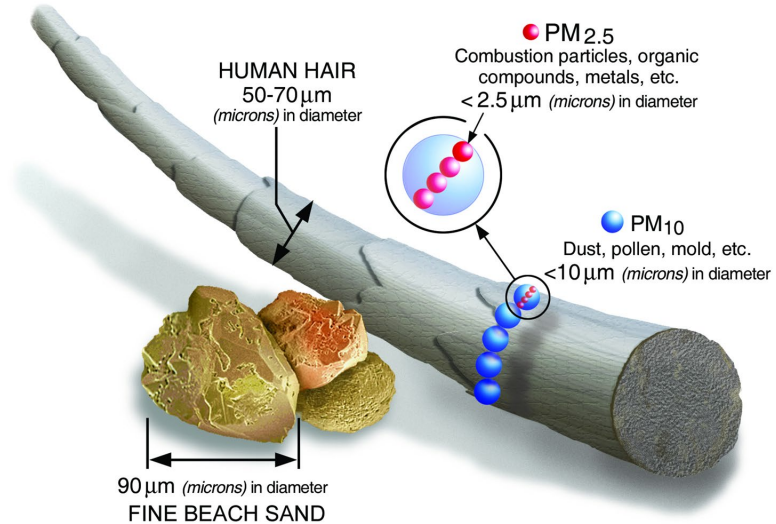
Why is it important to have no-smoking policies in public spaces?

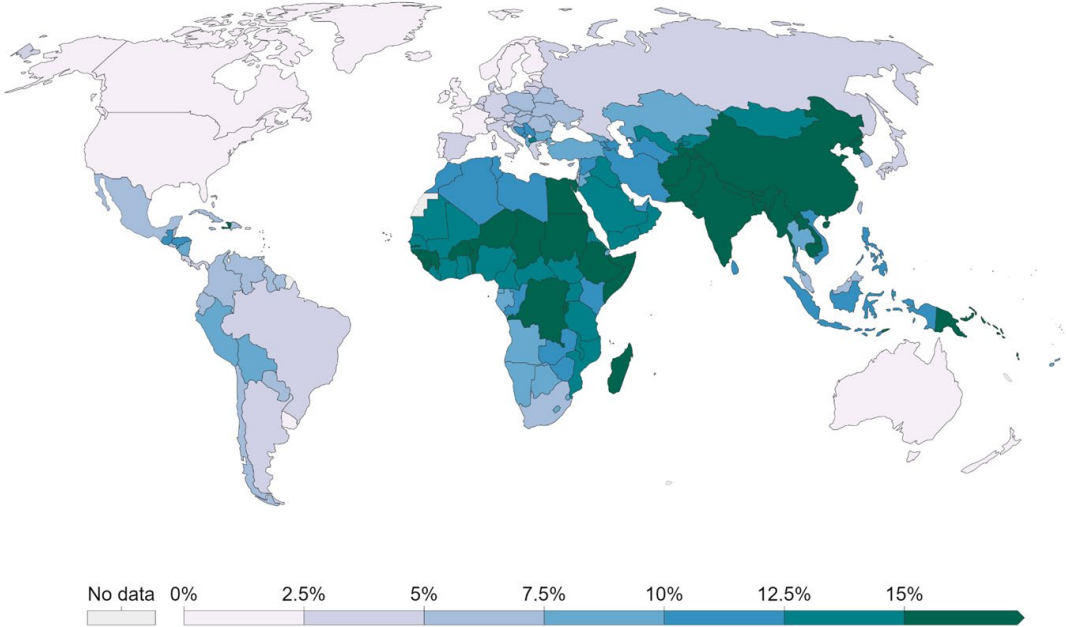# Extension: Disproportionate Impacts of Air Pollution

Share of deaths attributed to air pollution, 2019
Share of deaths, from any cause, which are attributed to air pollution – from outdoor and indoor sources – as a risk factor.

Our World in Data

No data   0%   2.5%   5%   7.5%   10%   12.5%   15%

Reveal of air pollution levels around town

Air Pollution Big Idea #1

Particulate matter is recorded in 3 sizes:

- **50 μm,** which is visible to our eyes.
- **10 μm,** which we can detect if it is *really* clumped together.
- **2.5 μm,** which we cannot see without very advanced lenses. THIS is the stuff we consider *pollution.*

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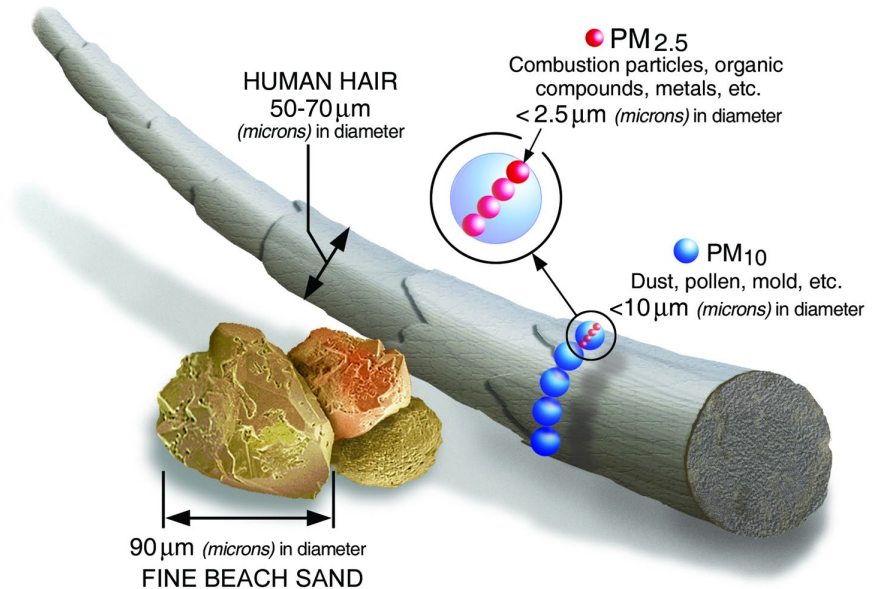
Air Pollution Big Idea #2

There are many sources (some manmade and some natural) of PM 2.5 in the air

Air Pollution Big Idea #3

PM 2.5 has direct effects on our health and our environment.

Air pollution has been linked to reduced lung function, development of asthma, lung disease, cancer, respiratory conditions, and an overall reduced life expectancy.

Through our use of air quality meters around school and town, we have identified some key patterns to figuring out what factors directly contribute to low air quality.

These observations include places with:

- More traffic
- More fires or burning stuff
- Less greenery and trees
- More human activity

Air Pollution around the World!

Now if these patterns hold true, then we should find similar trends in locations all over the world!
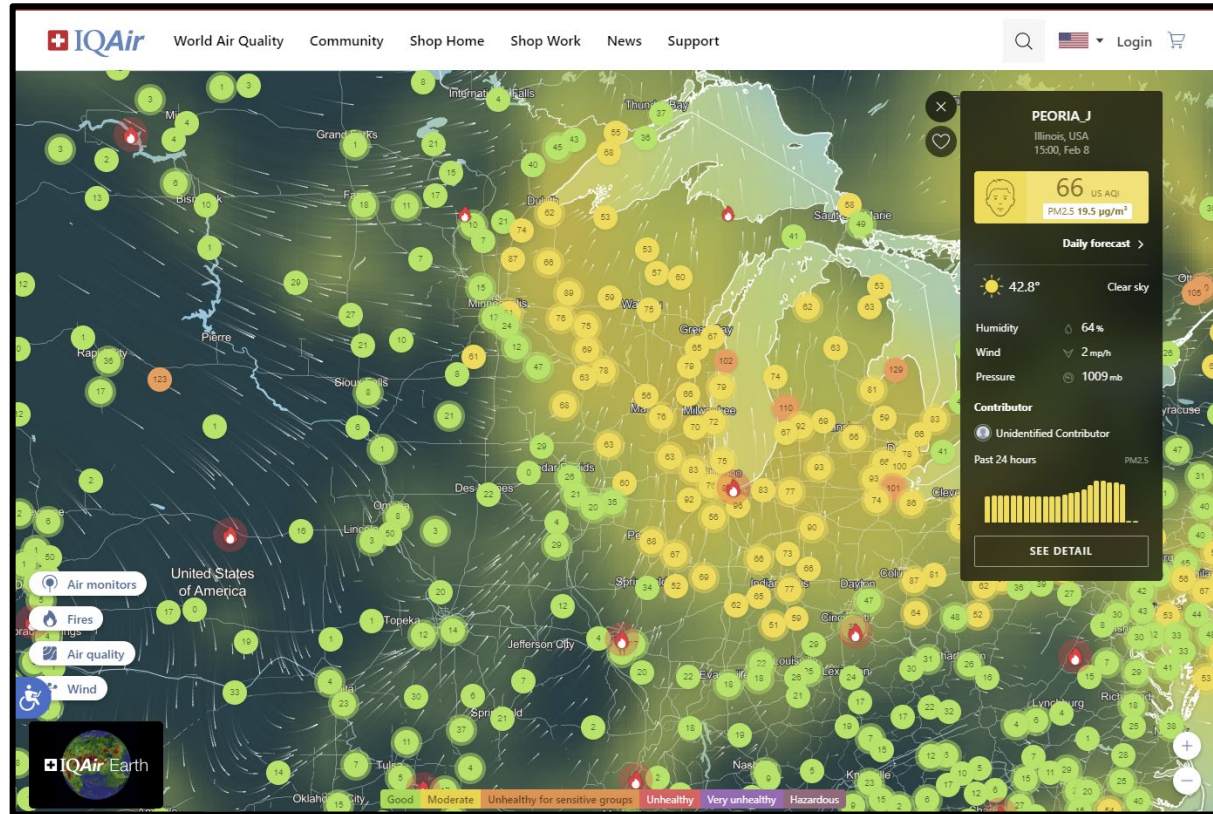
What are natural and man-made sources of air pollution?

Man-Made sources of air pollution result directly from human activities such as burning fuel in our cars and airplanes, burning coal to make electricity, and farming (especially livestock).

Natural sources of air pollution result from the forces of nature such as a forest fire, wind blowing up dust, pollen, or a volcanic eruption .
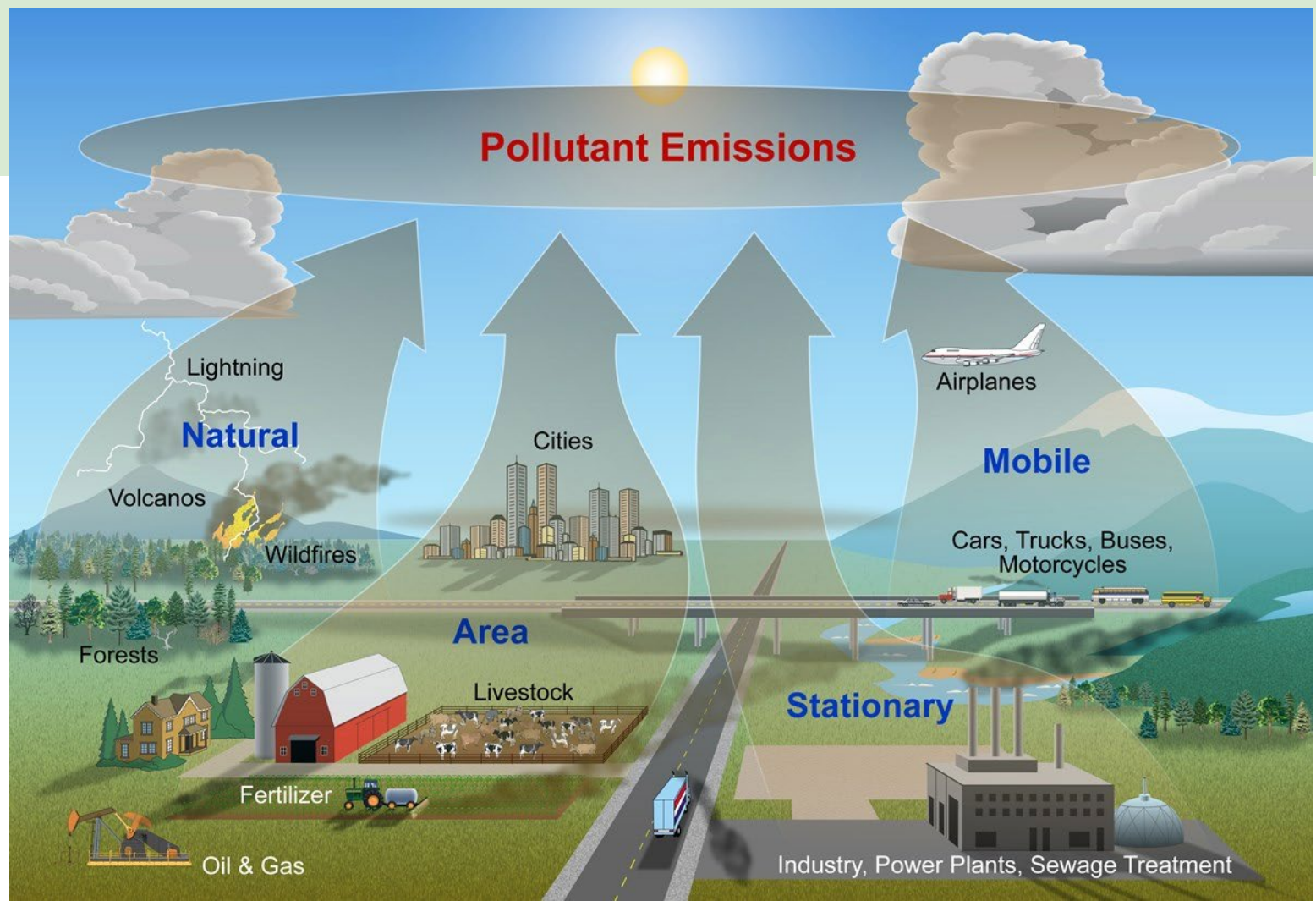
What factors can influence air quality of a community?

These sources of air pollution are directly tied to the local factors a community exhibits.

Man-Made

Influences on air quality are a result of things such as the amount of industry and factories, the amount of people living in that space, and the amount of vehicles and power plants used in that community

Natural

influences of air quality include geography (such as mountains and forests), daily weather, and local environmental policies that affect the environment.

Separating Natural Factors and Man Made Factors.

The key distinction is the "acting." In the man-made factors, human processes such as powering homes and cars, manufacturing things, traveling, and producing food create particles that pollute the air.

In natural factors, wind is moving particles into the air, mountains are blocking the flow of particles, and local government policies are making laws that regulate emissions.

Sources of Air Pollution

Contributions to Air Pollution

WHAT ARE THE SOURCES OF AIR POLLUTION?

Outdoor air pollution affects urban and rural areas and is caused by multiple factors:

INDUSTRY & ENERGY SUPPLY

DUST

TRANSPORT

AGRICULTURAL PRACTICES

HOUSEHOLD ENERGY

WASTE MANAGEMENT

Countries cannot tackle air pollution alone. It is a global challenge we must all combat together.

CLEAN AIR FOR HEALTH   #AirPollution   World Health Organization

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2019

- Agriculture 10%
- Commercial & Residential 13%
- Transportation 29%
- Electricity 25%
- Industry 23%
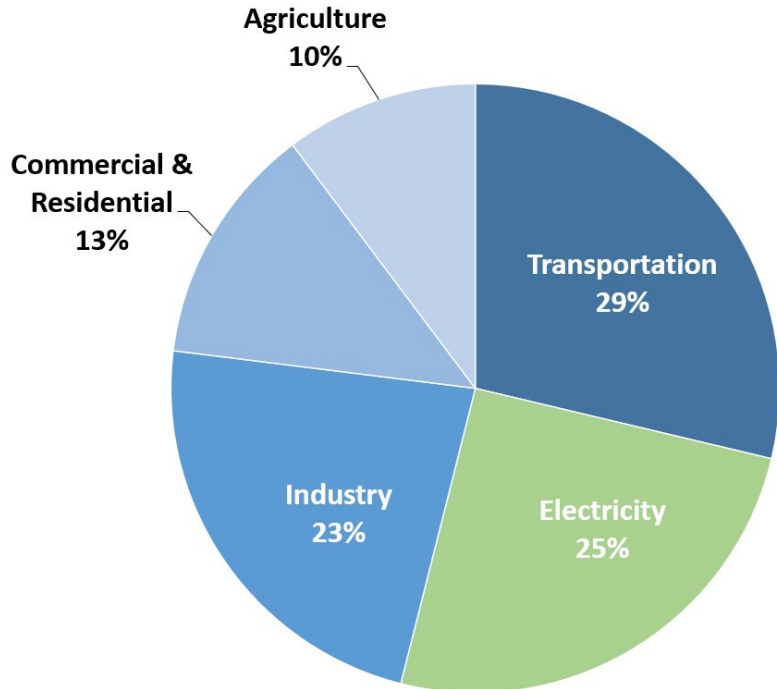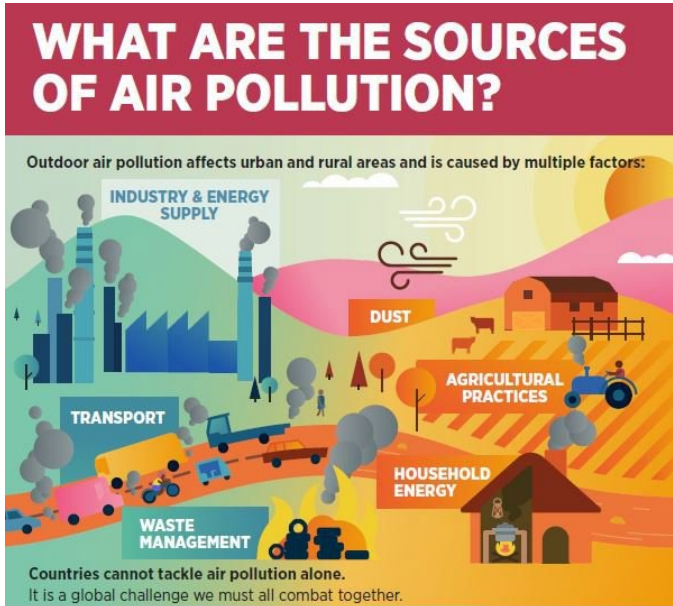
CARTEEH's Work on Air Pollution

TTI HEAT MAP SHOWS

Asthma cases attributable to traffic-related air pollution dramatically decreased between 2000 and 2010

Texas A&M Transportation Institute

CARTEEH
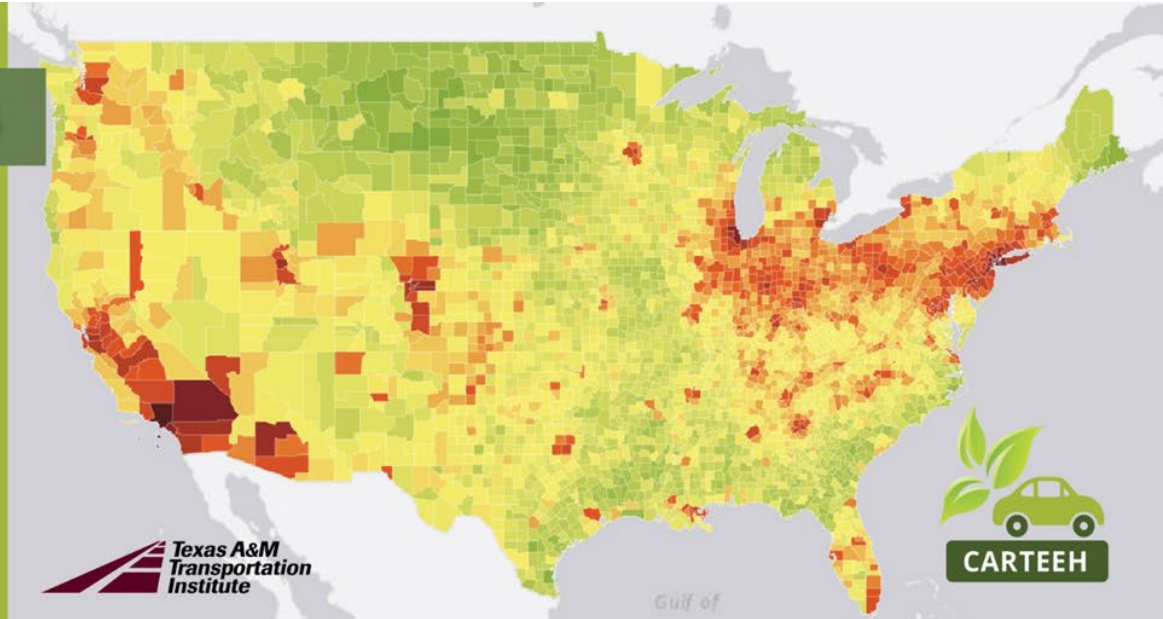
Contextualizing Air Pollution

Your next task will be to look at various communities with "excellent" and "awful" air quality and identify the factors that impact the air.

MYSTERY TOWN

Apply knowledge of air pollution
and sources

CNBC

WHY IS CLEAN AIR SO EXPENSIVE?

MYSTERY TOWN

MYSTERY TOWN

REVEAL!

Los Angeles, California

2020 Yearly Average PM 2.5 Levels: 14 (Min of 6, Max of 26)

What is the air quality?
- Among the worst in the United States for particulate matter.
- Does not meet EPA's national air quality standards.
- 1 in 10 children have been diagnosed with asthma and people have an increased risk of cancer.
- Lock–down measures from COVID-19 dramatically decreased air pollution due to a decrease in traffic.

What are sources of air pollution?
- **Large population:** Contributes to high emissions from cars and traffic congestion as well as power consumption and other local emissions.
- **Shipping ports:** Port of Los Angeles and Port of Long Beach have a high concentration of fossil fuel or diesel to power ships and other transportation.
- **Wildfires:** During the summer months with strong winds and dry conditions.
- **Geography:** Los Angeles is a basin surrounded by mountains that trap air pollution.

TOWN B
NEW YORK CITY, NEW YORK

2020 Yearly Average PM 2.5 Levels
6.5

Min level: 6
Max level: 9

New York City, New York

2020 Yearly Average PM 2.5 Levels: 6.5 (Min of 6, Max of 9)

What is the air quality?
- Despite being the most populous city in the United States, NYC has relatively little air pollution on average.
- Strict emission controls and has invested in increasing regulations on emission sources and improved monitoring of PM 2.5 levels.
- However, the current levels still pose a health threat with particulate matter leading to 3,000 deaths from heart and lung conditions every year. Reducing the particulate matter by 10% could reduce the number of deaths by 300 people every year.
- The COVID-19 lockdown resulted in 25% reduction in particulate pollution in a 3-week period.

What are sources of air pollution?
- **High population density:** Contributes to high emissions from cars and traffic congestion as well as power consumption and other local emissions.
- **Vehicle emissions:** from cars, trucks, ships, and planes.
- **Industry:** on the outskirts of the city.

TOWN C

MEDFORD, OREGON

2020 Yearly Average PM 2.5 Levels

16

Min level: 3
Max level: 92

Medford, Oregon

2020 Yearly Average PM 2.5 Levels: 16 (Min of 3, Max of 92)

What is the air quality?
- Moderate level of air quality.
- Recently seen record-breaking levels of air pollution.
- Pollution prevention policies have reduced vehicle emissions.

What are sources of air pollution?
- **Wildfires:** Oregon has been affected by some of the worst air quality in the world. With such dense concentrations of tiny particles from wood smoke, it's been considered unhealthy or even hazardous to breathe. The worst times are the end of June and the start of September.

TOWN D
HOUSTON, TEXAS

2020 Yearly Average PM 2.5 Levels
10

Min level: 8
Max level: 13

Houston, Texas

2020 Yearly Average PM 2.5 Levels: 10 (Min of 8, Max of 13)

What is the air quality?
- Generally good air quality.
- Improved air quality due to increased regulations on emissions, but PM 2.5 levels continue to increase each year.
- Higher-density parts of Houston have higher air pollution levels.
- Low-income areas of the city are disproportionately impacted by air pollution.
- Despite generally low air pollution, the PM 2.5 levels in Houston contribute to 5,000 premature deaths.

What are sources of air pollution?
- **Shipping port:** The Port of Houston is one of the nation's busiest, producing 4.1 tons of smog-forming pollution each year.
- **Vehicle emissions:** Resulting from a large number of cars and other transportation.
- **Industrial emissions:** Coming from factories such as concrete processing plants.

TOWN E
DETROIT, MICHIGAN

2020 Yearly Average PM 2.5 Levels
10

Min level: 7
Max level: 13

Town E

Detroit, Michigan

2020 Yearly Average PM 2.5 Levels: 10 (Min of 7, Max of 13)

What is the air quality?
- One of the most polluted cities in Michigan.
- While air pollution has been generally improving since the 2000s, annual particle pollution in Detroit is in the top five percent of all cities measured.
- The southwest section of the city is the most highly polluted region due to its dense concentration of heavy industry that emits higher levels of harmful particulate matter than other areas.

What are sources of air pollution?
- **Oil refinery**
- **Plants powered by coal:** Two plants alone release a combined 34,000 tons of sulfur dioxide into Detroit's air, contributing to fine particle pollution that causes harm to the lungs.
- **Multiple transportation corridors:**   Including heavily trafficked highways and a 6-lane bridge.
- **Wood burning:** Many homes burn wood in fireplaces to generate heat, especially during colder months.

TOWN F
WICHITA, KANSAS
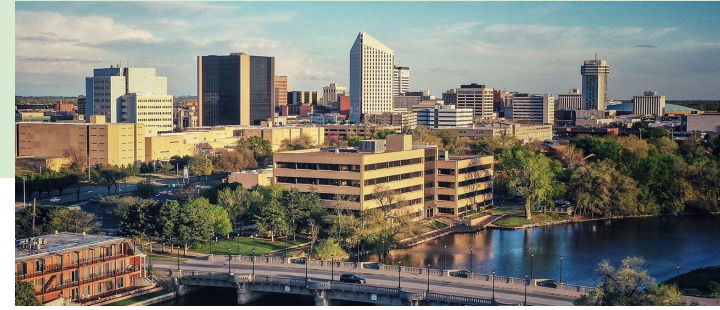
2020 Yearly Average PM 2.5 Levels
7

Min level: 5
Max level: 10

Town F

Wichita, Kansas

2020 Yearly Average PM 2.5 Levels: 7 (Min of 5, Max of 10)

What is the air quality?
- Good air quality levels,
- Yearly average within the World Health Organization's target goal of 10 µg/m³ or less for PM 2.5 levels,

What are sources of air pollution?
- **Wildfires:** Occasionally occur, and vast clouds of smoke and haze blow over from neighboring cities.
- **Transportation:** Being a large city, vehicular emissions are a concern with huge amounts of cars and other smaller personal vehicles on the road, along with larger heavy-duty vehicles such as trucks and buses.

Mystery Town Comparison of PM 2.5 Levels

PM₂.₅	Air Quality Index
0 to 12.0	Good 0 to 50
12.1 to 35.4	Moderate 51 to 100
35.5 to 55.4	Unhealthy for Sensitive Groups 101 to 150
55.5 to 150.4	Unhealthy 151 to 200

Town	Min	Max	Average	Air Quality
Los Angeles, California	6	26	14	Moderate
New York City, New York	6	9	6.5	Good
Medford, Oregon	3	92	16	Moderate *Sometimes Unhealthy*
Houston, Texas	8	13	10	Good *Sometimes Moderate*
Detroit, Michigan	7	13	10	Good *Sometimes Moderate*
Wichita, Kansas	5	10	7	Good

Ideas to Reduce Air Pollution

The cement in this building absorbs **smog** from the air.