

Mystery Town

The following Mystery Town activity is a way for students to apply knowledge learned about sources of air pollution. Students will determine the sources of air pollution and other contributing factors through an investigation of provided city demographics, maps, and weather charts. This activity is broken into two parts. First is a group activity, and the second part is for individual assessment.

Part 1: Group Work

1. Students will work in partners or small groups of 3 to compare three different towns in the US. Provide the first three towns (A, B, C) and the handouts.
2. While students are working, listen to conversations and ask guiding questions such as *How were the towns similar/different?, What evidence do you have for this source?, Why might one source of pollution be more significant than another in a particular town?*. Students will complete the provided chart, and they can attempt to guess the location of the Mystery Town based on clues provided (this part is just for fun!).
3. As a class, discuss the sources of air pollution that were identified. Reveal Mystery Town levels and sources of air pollution. *Did these match your predictions? What are the sources of air pollution? What is surprising? What are the health impacts?*
4. Find the mystery towns on <https://www.igair.com/us/>. Record the real-time measurement.

Part 2: Individual Assessment

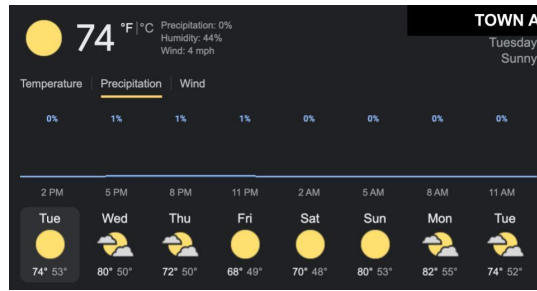
Students will now work individually to complete the same comparison of three new towns. They will complete the chart to describe sources of air pollution and then justify predicted levels. Additional questions will reveal their understanding of sources, health impacts, and how air quality is tied to population. A grading rubric is provided below.

Rubric for Mystery Town Individual Assessment			
	Score (1)	Score (3)	Score (5)
Sources of air pollution	Student is unable to identify sources of air pollution.	Student identifies some, but not all, of the sources of air pollution.	Student is able to accurately identify natural and manmade sources of air pollution in each town (i.e. shipping ports, vehicles, wildfires).
Human impact on air quality	Student does not identify human impact on air quality.	Student has an incomplete understanding of how population contributes to air quality.	Student understands that high population increases manmade sources such as vehicle emissions
Trends of air pollution	Student does not understand how air quality changes over time.	Student has an incomplete understanding of how air quality changes over time.	Student understands that air quality changes depending on weather conditions and natural events like wildfires.

Welcome to

TOWN A

Population 10 million



Local Information

Population Density: 7,009 people per square mile

of Registered Cars: 2,499,764

of Oil Refineries: 5

of Power Plants: 4

Average Rainfall: 14.93 inches per year

Average Snowfall: 0 inches per year



Things around Town

Note these photos are NOT from this town.



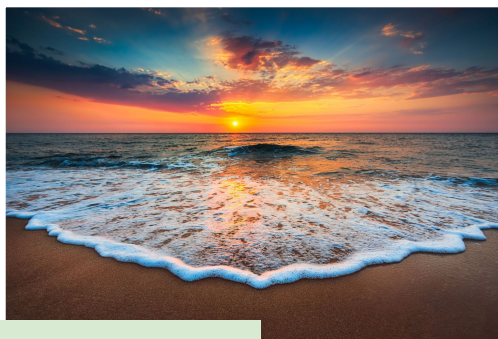
Traffic Jams



One of the busiest ports in the nation



Theme Parks & Tourism



Beautiful Beaches



Nearby wildfires

Welcome to

TOWN B

Population 8.5 million

Local Information

Population Density: 27,000 people per square mile

of Registered Cars: 4,800,000

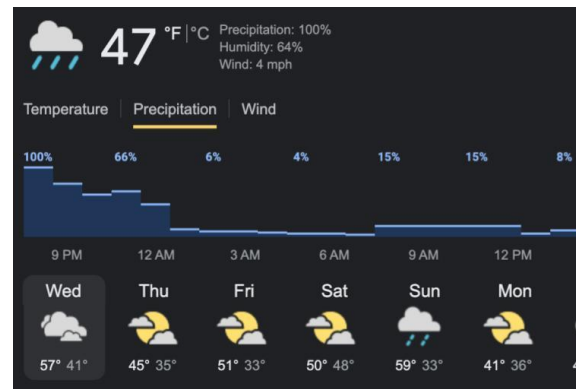
of Oil Refineries: 0

of Power Plants: 3 (2 are hydroelectric plants)

Average Rainfall: 46.6 inches per year

Average Snowfall: 25 inches per year

Note: The Mayor has relatively strict emission controls and set a goal to achieve the cleanest air of any large city by 2030.



Things around Town

Note these photos are NOT from this town.



Food & Culture



Tall buildings

Lots of people drive into the town for work



Various modes of transportation

Lots of people



Welcome to

TOWN C

Population 85,824

Local Information

Population Density: 3,828 people per square mile

of Registered Cars: 205,000 in county

of Oil Refineries: 0

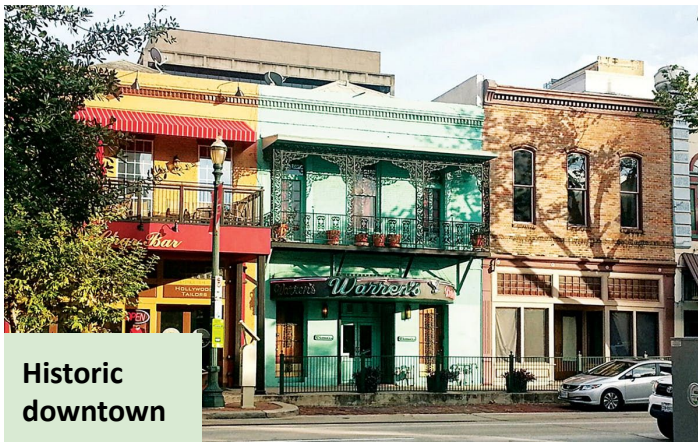
of Power Plants: 0

Average Rainfall: 18.4 inches per year

Average Snowfall: 4 inches per year

Things around Town

Note these photos are NOT from this town.



Welcome to TOWN D

Population 2,304,580

Local Information

Population Density: 3,632 people per square mile

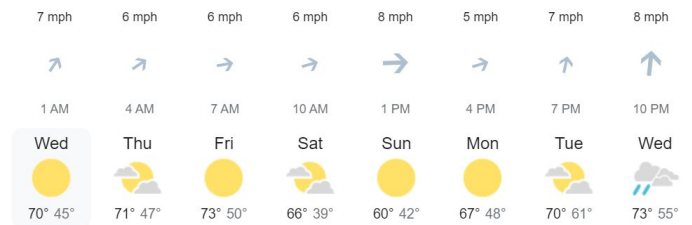
of Registered Cars: 3,424,674 in county

of Oil Refineries: 10

of Power Plants: 18

Average Rainfall: 50 inches per year

Average Snowfall: 0 inches per year



Things around Town

Note these photos are NOT from this town.

Large port
and
railroad
industry



International
Airport



Diverse
Community



Humid climate



Museum District



Welcome to

TOWN E

Population 4.3 million

Local Information

Population Density: 3,632 people per square mile

of Registered Cars: ~ 5 million

of Oil Refineries: 1

of Power Plants: 9

Average Rainfall: 33.5 inches per year

Average Snowfall: 33 inches per year



7 mph	10 mph	12 mph	13 mph	12 mph	13 mph	10 mph	9 mph
↑	↑	↑	↑	↑	↑	↑	↑
2 AM	5 AM	8 AM	11 AM	2 PM	5 PM	8 PM	11 PM
Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
38° 25°	33° 24°	39° 20°	24° 4°	19° 10°	25° 9°	31° 25°	42° 28°

Things around Town

Note these photos are NOT from this town.

Tourism & Music



International Airport



Automobile Industry



Large port



Transportation Hub



Welcome to TOWN F

Population 647,610

Local Information

Population Density: 2,425 people per square mile

of Registered Cars: ~ 700,000

of Oil Refineries: 0

of Power Plants: 3

Average Rainfall: 33.9 inches per year

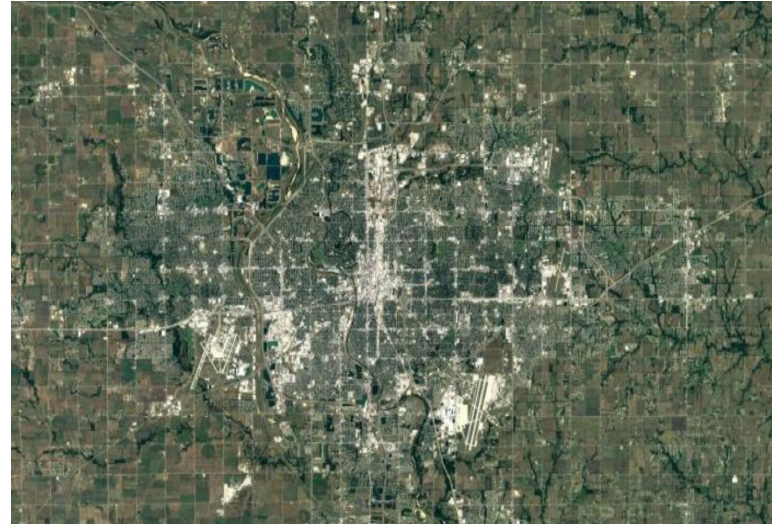
Average Snowfall: 12.7 inches per year

Things around Town

Note these photos are NOT from this town.



International
Airport

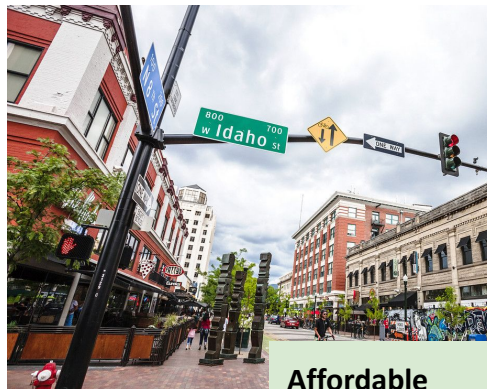


7 mph	7 mph	7 mph	10 mph	12 mph	13 mph	6 mph	4 mph
→	→	→	→	→	→	→	→
1 AM	4 AM	7 AM	10 AM	1 PM	4 PM	7 PM	10 PM
Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed
63° 36°	57° 41°	60° 23°	42° 26°	59° 28°	57° 40°	66° 38°	46° 23°



Aircraft
Manufacturing

Birthplace
of Pizza Hut



Affordable
place to live



Greenways and
parks

Mystery Town Activity: Answer Key

TOWN A: Los Angeles, California

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

Find live data here: <https://www.igair.com/us/usa/california/los-angeles>



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 of 6, Max of 9)

Find live data here: <https://www.igair.com/us/usa/new-york/new-york-city>



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.



Mystery Town Activity: Answer Key

TOWN C: Medford, Oregon

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

Find live data here: <https://www.iqair.com/us/usa/oregon/medford>

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 of 8, Max of 13)

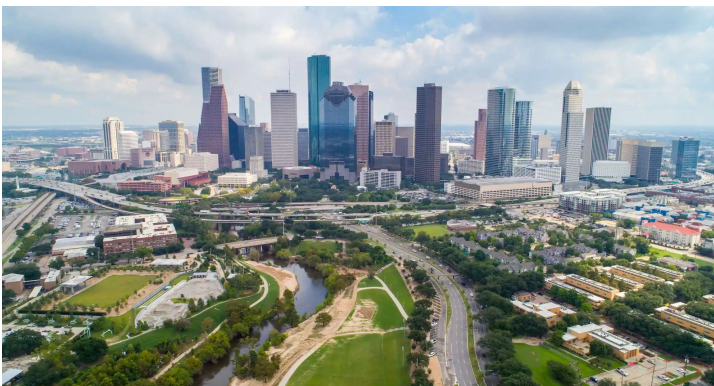
Find live data here: <https://www.iqair.com/us/usa/texas/houston>

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.



Mystery Town Activity: Answer Key

TOWN E: Detroit, Michigan

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

Find live data here: <https://www.iqair.com/us/usa/michigan/detroit>

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 of 5, Max of 10)

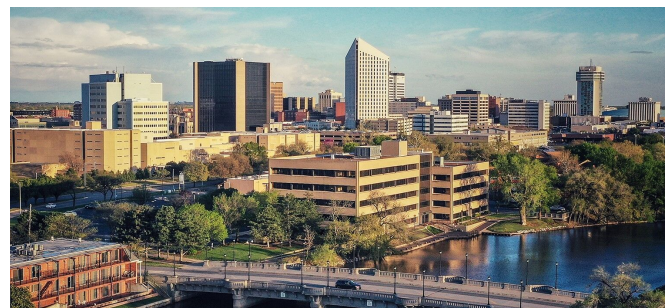
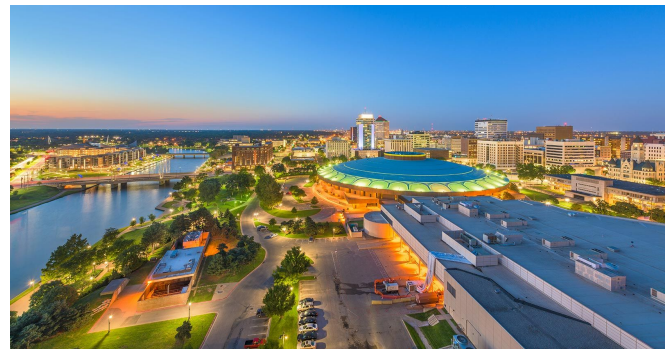
Find live data here: <https://www.iqair.com/us/usa/kansas/wichita>

What is the air quality?

- Good air quality levels,
- Yearly average within the World Health Organization's target goal of 10 $\mu\text{g}/\text{m}^3$ 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 Activity: Part 1

Names:

Review the town data provided and complete the following chart based on provided information.

TOWN	Which features might be sources of air pollution?	Which features might reduce air pollution levels?	Guess for Air Quality Level <i>Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy</i>
A			
B			
C			

PM _{2.5}	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

Mystery Town Activity: Group

1. Which town do you predict will have the highest level of air pollution? Justify your answer.

2. Which town do you predict will have the lowest level of air pollution? Justify your answer.

3. What additional information would be useful to know about each town to help predict air quality? Why?

4. Which town is most similar to where you live? Why?

PM _{2.5}	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

Mystery Town Activity

Copy over your prediction for air quality levels, and see if you can guess the town - just for fun! Then, ask your teacher for the answer key. Complete the table below. Find the current live PM 2.5 level at <https://iqair.com/>

TOWN	Guess the Town	Predict Air Quality Level	Name of Town	PM 2.5 levels Min, Max, Average, Current	Major Sources of Air Pollution
A					
B					
C					

Mystery Town Activity: Part 2

Name:

Review the town data provided and complete the following chart based on provided information.

TOWN	Which features might be sources of air pollution?	Which features might reduce air pollution levels?	Guess for Air Quality Level <i>Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy</i>
D			
E			
F			

PM _{2.5}	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

Mystery Town Activity: Individual Assessment

1. Which town do you predict will have the highest level of air pollution? Justify your answer.

2. Which town do you predict will have the highest level of air pollution? Justify your answer.

3. Why does a city with high population density generally have increased PM 2.5 levels?

4. Why might the levels of air pollution change over time in a city?

PM _{2.5}	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

Mystery Town Activity: ANSWER KEY

6. Copy over your prediction for air quality levels, and see if you can guess the town - just for fun! Then, ask your teacher for the answer key. Complete the table below. Find the current live PM 2.5 level at <https://iqair.com/>

TOWN	Name of Town	PM 2.5 levels Min, Max, Average, Current	Major Sources of Air Pollution
A	Los Angeles, California	2020 Yearly Average PM 2.5 Levels: 14 (Min of 6, Max of 26)	Large population: Contributes to high emissions from cars and traffic congestion as well as power consumption and other local emissions. Shipping ports: 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: A basin surrounded by mountains that trap air pollution.
B	New York City, New York	2020 Yearly Average PM 2.5 Levels: 6.5 (Min of 6, Max of 9)	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.
C	Medford, Oregon	2020 Yearly Average PM 2.5 Levels: 16 (Min of 3, Max of 92)	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.
D	Houston, Texas	2020 Yearly Average PM 2.5 Levels: 10 (Min of 8, Max of 13)	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.
E	Detroit, Michigan	2020 Yearly Average PM 2.5 Levels: 10 (Min of 7, Max of 13)	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.
F	Wichita, Kansas	2020 Yearly Average PM 2.5 Levels: 7 (Min of 5, Max of 10)	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