

## Mapping Air Pollution in Oakland, CA Classroom Activity

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Introduction

The American Lung Association reported that in 2017, nearly 40% of Americans live in counties with unhealthy air quality, with 8 out of the 10 most polluted cities in the United States in California. In addition to greenhouse gases, other common pollutants from burning fossil fuels include Black Carbon, Nitric Oxide (NO), and Nitrogen Dioxide (NO<sub>2</sub>). These three pollutants are strongly associated with heavy traffic and contribute to smog and acid rain, as well as increased risk of respiratory issues like asthma and lung cancer. California in particular has faced poor air quality due to climate change, as warmer temperatures increase the production of smog.

### Context Video



[Youth Climate Story: Air Pollution in Los Angeles](#)

## Vocabulary

**Isoline:** a line on a map that connects points of equal value.

**Heat map:** a map where data values are represented as colors.

**Parts per billion (ppb):** the amount of a substance for every 1 billion particles. *Ex. 20 ppb of NO is equivalent to saying there are 20 particles of NO for every 1 billion particles.*

## Objective

You will draw isolines to create a heat map of Nitric Oxide (NO) air pollution in Oakland, CA.

## Materials

Pencil, colored pencils (red, orange, yellow, green)

## Procedure

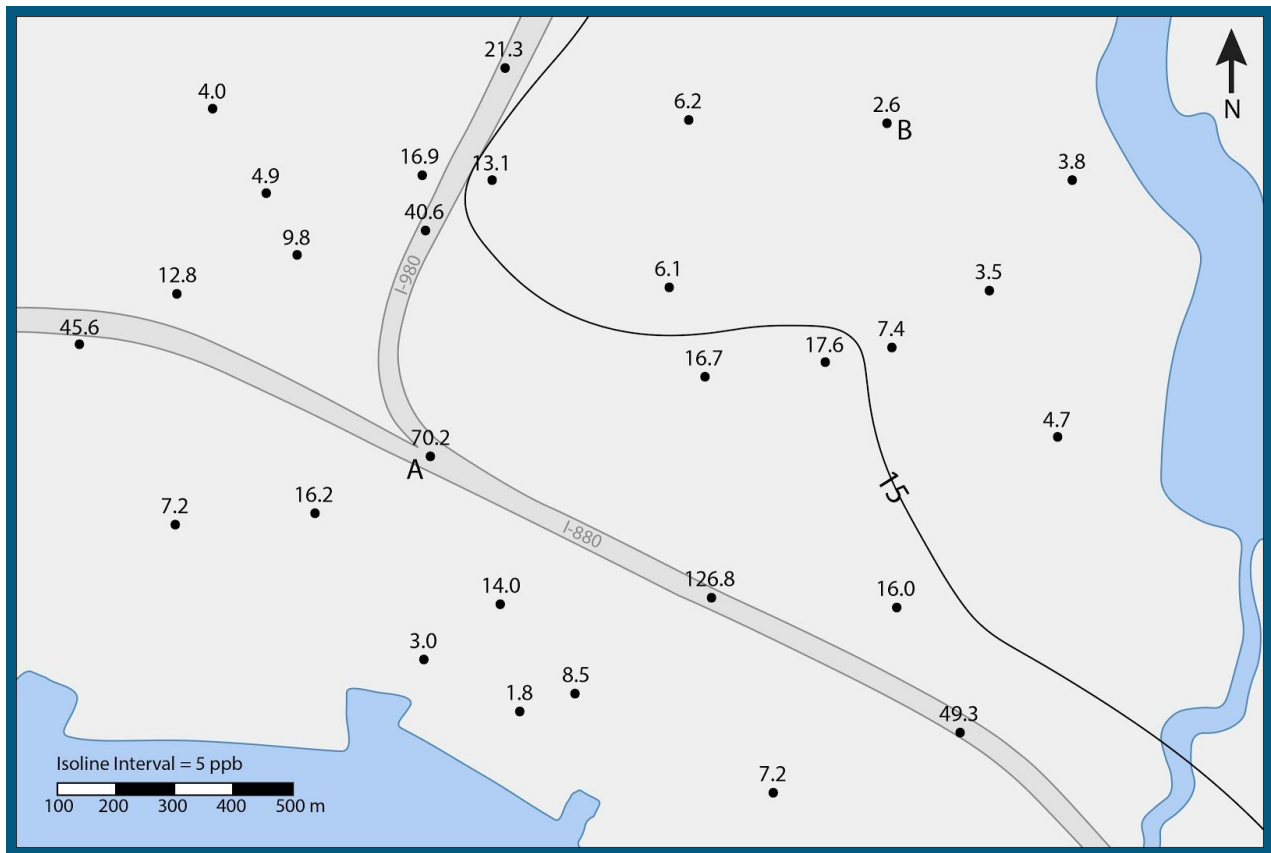
1. Refer to these important rules for drawing isolines:
  - Each point on a given isoline has the same value
  - Isolines never touch or cross
  - Isolines form closed loops but they will appear open when they run off the edge of the map
  - All values on one side of the isoline will be larger than the isoline value, and all values on the other side will be smaller than the isoline value.
  - On an isoline map, the interval between each line is the same
2. On the map provided on page 2, use a pencil to draw the **5 ppb** isoline by creating a small x in between two values 5 ppb falls between. Connect the x's and label the isoline.
3. Create and label isolines for **10 ppb**, **15 ppb**, and **20+ ppb**. Note: One portion of the 15 ppb isoline is already completed and labeled for you. You will need to complete the remaining 15 ppb isoline.
4. Using colored pencils, color in the space between 5 and 10 ppb with green, between 10 and 15 ppb with yellow, between 15 and 20 ppb with orange, and 21+ ppb with red.

## Sources & References

- [EDF - Mapping pollution with mobile sensors](#)
- [EDF - A tale of two freeways: Policy choices matter](#)
- [The Washington Post - The 10 most polluted cities in the U.S.](#)
- [CBS News - U.S. cities with the worst air pollution](#)
- [NRDC - Air Pollution: Everything You Need to Know](#)

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**Discussion Questions:** Answer using data from the lab in complete sentences.

- 1) What is the lowest recorded value for Nitric Oxide (NO) on the map? What is the highest recorded value?
  
- 2) Based on the map, what can you infer to be the main cause of Nitric Oxide (NO) pollution in Oakland, CA?

- 3) What is the distance between points A and B? Hint: Using the edge of a piece of paper, make markings along point A and point B on the map and transfer it along the scale to determine the distance between the two points.
  
- 4) A gradient is the change in value between two points on a map. It is calculated using this formula: **Gradient = change in field value/distance**. What is the gradient between point A and point B?
  
- 5) Which community would you expect to have a higher risk of respiratory issues such as asthma or lung cancer, point A or point B? Why?

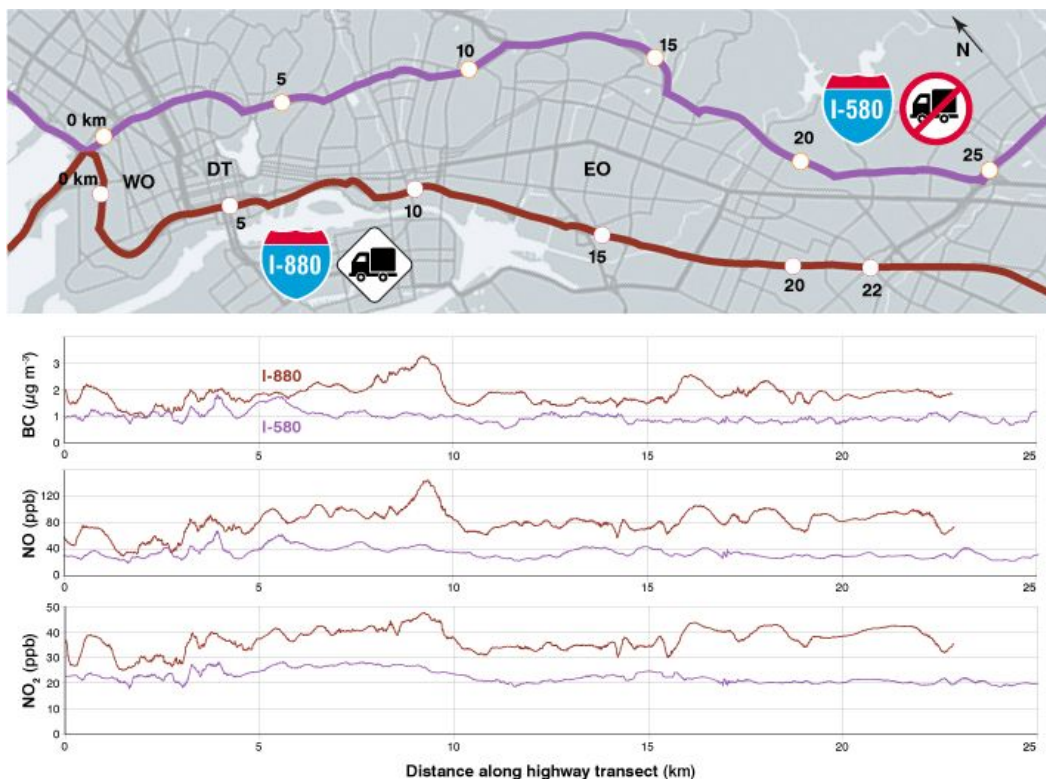
**Reading Comprehension:** Read an excerpt of the article on air pollution along two freeways in Oakland, CA below and answer the following questions using complete sentences.

**A tale of two freeways: Policy choices matter**

[Environmental Defence Fund](#)

Air pollution along freeways is generally higher than in surrounding areas. Even so, the I-880 freeway in Oakland, Calif., has much higher levels of pollution than the nearby I-580.

Data shows that concentrations of black carbon along I-880 were roughly 60% higher than average concentrations along I-580, concentrations of NO<sub>2</sub> were nearly 50% higher, and concentrations of nitric oxide (NO) were roughly double.



**Banning trucks on I-580**

Oakland is an important logistics hub and the [fifth-busiest container port](#) in the country. That means a lot of diesel-powered ships, trucks and trains. Companies rely on freeways to move products from the Port of Oakland out to the California and U.S. markets.

When I-580 was built in 1963, Caltrans and the Federal Highway Administration banned all trucks weighing more than 4.5 tons. Because of the truck ban on I-580, the vast majority of Oakland’s freight-related traffic runs along I-880. Largely protected from this diesel-fueled traffic, the I-580 enjoys substantially cleaner air.

In 1999, the California Trucking Association asked Caltrans to re-evaluate the ban because of increasing congestion on the I-880. In response to strong local opposition, Caltrans abandoned the study, and the [ban continued](#). As a result, the I-580 remains the only interstate freeway in the nation that is not open to trucks<sup>1</sup>.

While supporters of the truck ban credit the policy for creating a better quality of life in communities near I-580, opponents point out that rerouting diesel truck traffic onto I-880 has led to congestion and a greater burden on other



communities. As it happens, the majority of people who live near the I-880 are people of color and those who are poor and working class.

#### **How air pollution affects health**

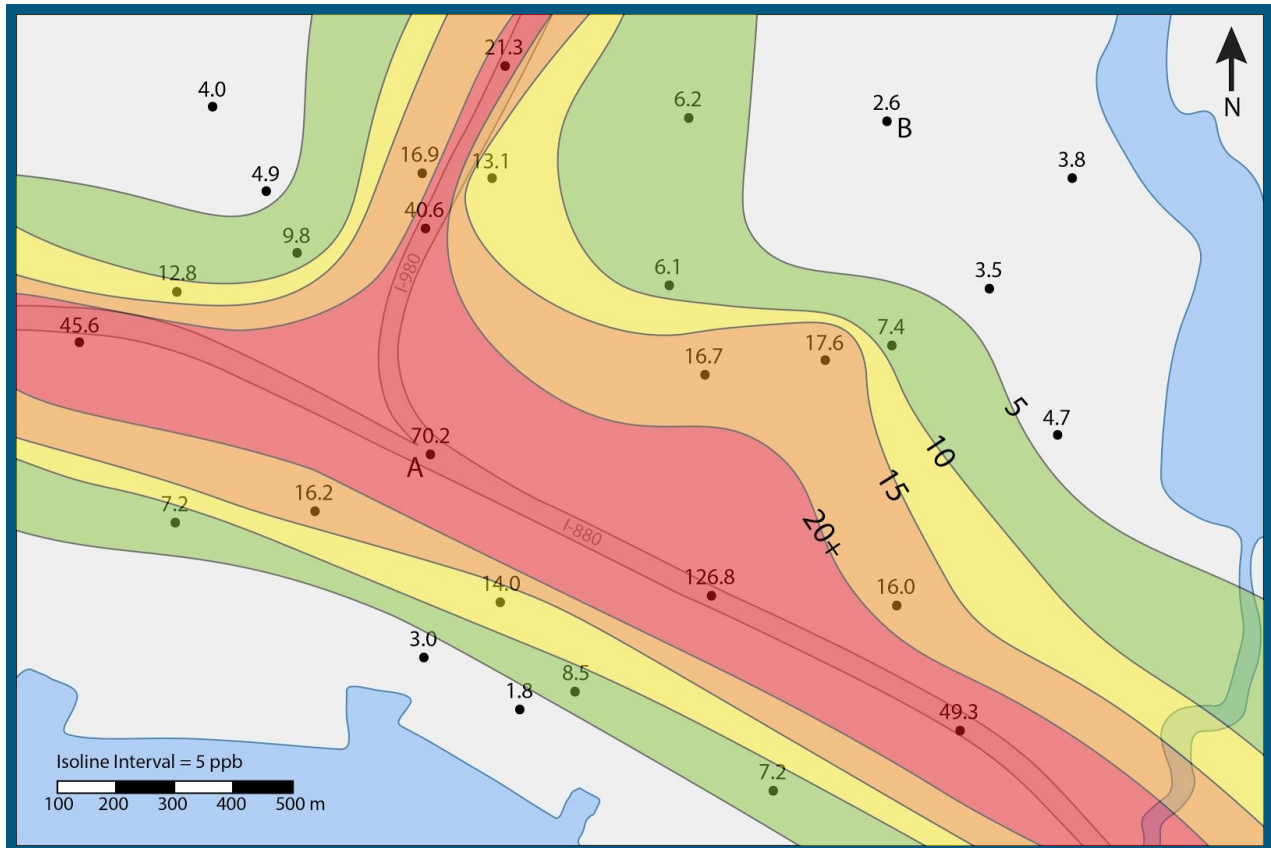
People with higher levels of chronic exposure to air pollution have a higher risk of health problems, including asthma, cardiovascular diseases and certain types of cancer. Highways with lots of diesel traffic have higher levels of pollution like black carbon, which can increase the risk of heart attacks and stroke and cause hypertension, asthma, chronic obstructive pulmonary disease (COPD), bronchitis and various types of cancer.

[Alameda County health data](#) [PDF] shows that people who grow up near the I-880 freeway in Oakland live seven years less than people who grow up near the I-580 in the more affluent Oakland hills. Differing levels of air pollution can contribute to such differences in health indicators.

#### **Reading Questions:**

- 1) Using the Nitric Oxide (NO) vs. Distance along highway transect graph on page 3, at approximately what distance along the highway transect is there the most Nitric Oxide (NO) pollution? How much Nitric Oxide (NO) pollution is there at this point along I-880?
- 2) How much Nitric Oxide (NO) pollution is at the same distance along I-580?
- 3) Why does Oakland rely so much on freeways?
- 4) How does air quality differ between I-580 and I-880? How does this difference create injustice for certain communities?
- 5) What are some health implications caused by black carbon pollution?
- 6) (Optional) Connect with your representatives to stand up for clean air. Your teacher can provide you with links from the article above to take action.

## Teacher Answer Key: Mapping Air Pollution in Oakland, CA



**Discussion Questions:** Answer using data from the lab in complete sentences.

- 1) What is the lowest recorded value for Nitric Oxide (NO) on the map? What is the highest recorded value?

**The lowest value on the map is 1.8 ppb. The highest value is 126.8 ppb.**

- 2) Based on the map, what can you infer to be the main cause of Nitric Oxide (NO) pollution in Oakland, CA?

**The main causes of Nitric Oxide (NO) in Oakland, CA are the highways I-880 and I-980.**

- 3) What is the distance between points A and B? Hint: Using the edge of a piece of paper, make markings along point A and point B on the map and transfer it along the scale to determine the distance between the two points.

**The distance between points A and B is ~1250 meters.**

- 4) A gradient is the change in value between two points on a map. It is calculated using this formula: **Gradient = change in field value/distance**. What is the gradient between point A and point B?

Gradient = change in field value/distance

Gradient AB = (70.2 ppb - 2.6 ppb)/1250 m

Gradient AB = 67.6 ppb/1250 m

Gradient AB = 0.05 ppb/m

- 5) Which community would you expect to have a higher risk of respiratory issues such as asthma or lung cancer, point A or point B? Why?

Communities that live near point A would have a higher risk of respiratory issues than communities near point B.

### Reading Questions:

- 1) Using the Nitric Oxide (NO) vs. Distance along highway transect graph on page 3, at approximately what distance along the highway transect is there the most Nitric Oxide (NO) pollution? How much Nitric Oxide (NO) pollution is there at this point along I-880?

There is about 45 ppb of NO along this distance on I-580.

- 2) How much Nitric Oxide (NO) pollution is at the same distance along I-580?

Oakland relies on freeways because it's the fifth-busiest container port in the country, which means there are a lot of diesel-powered ships, trucks, and trains.

- 3) Why does Oakland rely so much on freeways?

The air quality along I-580 is better than the quality of air along I-880. As a result, (a) More congestion along i-880 from traffic that cannot use I-580 leads to poorer air quality for communities that are majority people of color, poor, and working class, and (b) People who grow up near i-880 live seven years less than people who grow up near the i-580 due to difference in air quality.

- 4) What are some health implications caused by black carbon pollution?

Black Carbon can increase the risk of heart attacks, stroke, and cause hypertension, asthma, chronic obstructive pulmonary disease (COPD), bronchitis and various types of cancer.