



Connecting Social Issues & Human Health

Inequities Unit Lesson 2

Environmental Factors

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Grade Level	9th – Undergraduate Grade	Time Frame	360-420 minutes
Subject	Science	Duration	6-7 periods
Course	Biology I, Environmental Science		

Essential Question

How do inequitable environmental factors affect human health?

Summary

During this second lesson in the Connecting Social Issues and Health Inequities unit, students analyze Oklahoma City's Air Quality and pollutant levels from 2020 and summarize important information about air pollutants in a public service announcement.

Snapshot

Engage

Students view an image of a hazy, ozone alert day in Oklahoma City and discuss what they know about an ozone alert.

Explore

In groups, students evaluate data collected in 2020.

Explain

Students create anchor charts to summarize their data.

Extend

Students compare Oklahoma City air quality data from 2017 to 2020.

Evaluate

Students create public awareness content (book/podcast/song/video) at the level of a child about one air pollutant they learned about.

Standards

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Attachments

- [Carbon-Monoxide-Environmental-Factors.docx](#)
- [Carbon-Monoxide-Environmental-Factors.pdf](#)
- [Driving-Question-Board.docx](#)
- [Driving-Question-Board.pdf](#)
- [Lead-in-Air-Environmental-Factors.docx](#)
- [Lead-in-Air-Environmental-Factors.pdf](#)
- [Lesson-Slides-Environmental-Factors.pptx](#)
- [Nitrogen-Dioxide-Environmental-Factors.docx](#)
- [Nitrogen-Dioxide-Environmental-Factors.pdf](#)
- [Ozone-Environmental-Factors.docx](#)
- [Ozone-Environmental-Factors.pdf](#)
- [Particulate-Matter-Environmental-Factors.docx](#)
- [Particulate-Matter-Environmental-Factors.pdf](#)
- [Rubric-for-Air-Quality-and-Asthma-PSA.docx](#)
- [Rubric-for-Air-Quality-and-Asthma-PSA.pdf](#)
- [Sulfur-Dioxide-Environmental-Factors.docx](#)
- [Sulfur-Dioxide-Environmental-Factors.pdf](#)

Materials

- Lesson Slides- Environmental Factors (attached)
- Carbon Monoxide- Environmental Factors (attached; one per group)
- Lead in Air- Environmental Factors (attached; one per group)
- Nitrogen Dioxide- Environmental Factors (attached; one per group)
- Ozone- Environmental Factors (attached; one per group)
- Particulate Matter- Environmental Factors (attached; one per group)
- Sulfur Dioxide- Environmental Factors (attached; one per group)
- Public Service Announcement Rubric- Environmental Factors (attached; one per student)
- One device with internet connection per student if possible

Engage

Begin the lesson with **slide 3** of the attached [Lesson Slides](#). Project the [image of hazy summer day](#) in Oklahoma City.

Ask students the following questions:

- Have they ever heard of an ozone alert day?
- What does “ozone alert” mean?
- How can citizens protect themselves when an ozone alert has been made?

Encourage students to share any prior, relevant experience that might be beneficial throughout the lesson. Record student responses on the board to use in later whole group discussions.

Display **slides 4 and 5** to review the lesson’s essential question and learning objectives.

Explore

Teacher's Note

Assign each group of 3-5 students a time frame for them to review data for two consecutive months. For example, have Group 1 review data from January through February 2020.

Divide students into groups of 3-5 to evaluate real data collected in 2020. Assign them a specific time period.

Display **slide 6**. Share the sample data from January through February 2019.

Walk students through the steps to copy and paste their data into a spreadsheet.

Display **slide 7**. Share the sample graph generated from the data on **slide 6**. Walk students through the steps to create a graph with their data.

Display **slide 8**. Instruct students to go to the [Oklahoma Department of Environmental Quality](https://www.deq.state.ok.us/) (DEQ) website and pull the data for their time period (Oklahoma City two month- period in 2020). Using the OK-DEQ website, have them create line graphs.

- Each **group** will create a graph for each pollutant by day.
- Each **person** in the group will create at least one graph and research the corresponding pollutant.

For example, Group 1 analyzes data from January through the end of February to create six graphs (CO, Ozone, NO₂, SO₁, PM_{2.5}, and PM₁₀). They will use a graphing tool in Google Sheets or Excel. Graphing this information will help students identify patterns in the data.

Group assignments for graphing exercise:

- Group 1: January & February
- Group 2: March & April
- Group 3: May & June
- Group 4: July & August
- Group 5: September & October
- Group 6: November & December

Display **slide 9**. Instruct students to remain in their groups. Pass out one copy of each of the following handouts to each group:

- [Carbon Dioxide Environmental Factors](#)
- [Lead in the Air Environmental Factors](#)
- [Nitrogen Dioxide Environmental Factors](#)
- [Ozone Environmental Factors](#)
- [Particulate Matter Environmental Factors](#)
- [Sulfur Dioxide Environmental Factors](#)

Share the instructional strategy, [jigsaw](#), with students and instruct them to read one of the informational pages and become well enough acquainted with the content to be considered “expert.” While the “experts” are reading their pages, they should record questions and observations that they will share with their group.

Teacher's Note: Informational Pages

The original informational pages are written with the general public in mind but they will likely contain words that your students don't recognize. You may choose to have your students read the ones provided by the Oklahoma Department of Environmental Quality, or have them read a revised version that is provided in the attachments. The average reading level for the attached handouts is approximately 9th grade. The average reading level for the originals is included next to the link.

- [Carbon Monoxide](#): 12th grade
- [Lead](#): 10th grade
- [Nitrogen Dioxide](#): 11th grade
- [Ozone](#): 10th grade
- [Sulfur Dioxide](#): 10th-11th grade
- [Particulate Matter \(PM\)](#): 10th grade

Once all of your students have completed the reading, display **slide 10**. Instruct students to assemble as groups made up of classmates who read about the same pollutant. Ask them to share the questions and observations they wrote along the side of their paper with the new group. As their partners are sharing out, they should include any additional observations or questions they didn't originally write down.

After students share their questions and observations, display **slide 11** and instruct your students to go back to their original group and an "expert" will share what they learned from each of the informational pages.

Display **slide 12**. Ask students to capture questions and relevant information for the class [Driving Question Board](#). Either pass out the [Driving Question Board handout](#), or have students write their questions on a white board or chart.

As a group, students should be able to respond to the following questions about each of the pollutants (**slides 13-17**):

- What do we know?
- What does this information mean?
- What information do we still need?

Teacher's Note: Formative Assessment

To formatively assess students in the section above, listen in on their group discussion when they debrief the informational pages. If students have misconceptions, ask them probing questions to better understand why they think what they do. Additionally, you should listen to student conversations at the end of this section to see what they are gaining from the informational pages and the data.

Explain

Display **slide 19**. Ask students to assemble in their original groups. Instruct students to create an [Anchor Chart](#) that includes the following:

1. Analysis of their designated time period.
2. Knowledge of how pollutants interact with one another.
3. Knowledge of how pollutants affect humans.
4. Group answers to the following questions:
 1. *What do we know?*
 2. *What does this information mean?*
 3. *What information do we still need?*

Advise students to create a visually strong Anchor Chart that includes a mixture of words, pictures, and diagrams. Since each group examined two-month periods, ask students to look at the entire year.

Ask them to look for trends in ozone levels. Once the groups have finished their Anchor Charts, have them post them around the room.

Display **slide 20**. Have students do a [Gallery Walk](#) and record observations and questions they still have.

Teacher's Note: Student Observations

Once students have completed the gallery walk, hold a whole-group discussion beginning with student observations and questions. At this point, students should see trends in the data such as “increasing temperatures will increase the likelihood of an ozone alert day.” They should also notice that these pollutants can be extremely harmful.

Teacher's Note: Formative Assessment

Pay close attention to the information that students are sharing with one another. At this point in the lesson, if you hear misconceptions help students to understand what they are missing. Students should be able to connect ozone alert days to the months of May and August.

Extend

Once students have a clear understanding of the types of air pollution, the effects, and how they are measured, display **slide 21**.

Ask students to compare 2020 data to the 2017 data reflected on this slide.

Teacher's Note: Timing

This activity is tangentially related to the overall storyline and could be left out if time doesn't permit.

Create a class Google Slides document and have students copy their graphs onto the common document.

Display **slide 22**. share the accumulated data with your students, and discuss the following prompts:

- What does this information mean?
- What information do we still need?
- What differences did you notice between 2020 & 2017?
- What similarities did you notice between 2020 & 2017?
- Why would these differences occur? Why do you think this?

Display **slide 23**. This is a good time for you to refer to the Driving Question Board and ask students if they have answered any questions that were originally added to the board. Additionally, ask if there are new questions that should be added to the Driving Question Board.

Evaluate

Display **slide 24**. Hand out the attached [Public Service Announcement Rubric](#), and instruct students to create public awareness content that is at the level of a child (approximately age 5-10), related to air pollution, and includes any important information that they think the public should know. Inform students that they may choose to put the content in the form of a book, poster, podcast, song, or video to bring awareness to the harmful effects of air pollution.

Encourage students to think about how they might describe the connection between air quality and asthma to a younger sibling or family member. Student PSAs should also explain why our bodies respond to air pollution in this way.

Resources

- American Council of Science and Health. (2016, January 27). *Here's why carbon monoxide is so dangerous*. [Infographic]. <https://www.acsh.org/news/2016/01/27/why-carbon-monoxide-is-so-dangerous>
- Britannica. (2000). *Chemistry of acid deposition*. [Image]. <https://www.britannica.com/science/acid-rain/Chemistry-of-acid-deposition>
- Butcher, K. (2018, May 17). *Ozone Alert Day issued for Oklahoma City, Tulsa metro areas for Thursday*. KFOR.com Oklahoma City. <https://kfor.com/news/ozone-alert-day-issued-for-oklahoma-city-tulsa-metro-areas-for-thursday/>.
- Haggstrom, M. (2015, June 7). *Symptoms of lead poisoning (raster)*. [Image]. [https://commons.wikimedia.org/wiki/File:Symptoms_of_lead_poisoning_\(raster\).png#file](https://commons.wikimedia.org/wiki/File:Symptoms_of_lead_poisoning_(raster).png#file)
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- NASA/JPL-Caltech. (2020, October 21). *Particulate matter air pollution is associated with numerous adverse health effects*. <https://climate.nasa.gov/news/3027/getting-to-the-heart-of-the-particulate-matter/>
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- Oklahoma Department of Environmental Quality (2020). *Sulphur dioxide*. <https://www.deq.ok.gov/documents/?deqattkeyword=sulfur&deqdivisons=all&documenttags%5B%5D=fact-sheets>
- Oklahoma Department of Environmental Quality. (2020, April). *Carbon Monoxide* [Fact sheet]. Retrieved from https://www.deq.ok.gov/wp-content/uploads/deqmainresources/CarbonMonoxide_04-2020.pdf
- Timmeko. (2011, Sept. 2). *The nitrogen cycle*. [Image]. Flickr. <https://flickr.com/photos/timmeko/6106058553/in/photostream/Flickr>
- United States Environmental Protection Agency. (n.d.). *Size Comparisons for PM Particles* [Digital image]. <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM>
- United States Environmental Protection Agency. (n.d.) *Sulfur dioxide (SO₂) pollution*. <https://www.epa.gov/so2-pollution>