

Sphere 5E Lesson Plan #2

Ozone Depletion

Melany Dunivan

SCED 547: Eyes on Earth

Endeavor STEM /Adams State University

Fall 2020

**Title:** Ozone Depletion

**Grade level:** 7<sup>th</sup> grade

**Time:** The activity will take about 3 class periods (45 min each).

**Materials:** A computer, student worksheet, ruler, pencils and a calculator.

**Summary:**

This lesson centers on the ozone depletion in the stratosphere. The students will learn about the difference between bad and good ozone, the benefits of good ozone in the upper atmosphere (stratosphere), and the causes of ozone depletion in the stratosphere and high concentration in the troposphere and how these are harmful to life on Earth. The students will also learn how NASA uses satellites to analyze and collect ozone hole data over Antarctica as the ozone layer has depleted and the ozone hole area has grown bigger since 1979. The information about the changes in the ozone hole provide valuable information about the past, present and future of our planet as ozone in the upper atmosphere (stratosphere) provides great protection to life on Earth from the sun's harmful ultraviolet (UV) radiation. Students will list things that humans can do to protect Earth's ozone.

**Engage:**

Students will view the NASA eClips Ozone Alert video:

<https://youtu.be/kMzkXPuWHLg>

Students demonstrate they learned about ozone, the difference between good and bad ozone, the benefits of good ozone, the causes and effects of bad ozone in the troposphere and how NASA collects ozone data by writing down their new understanding and questions from the video then answering these questions:

- 1) What is ozone?
- 2) What is the difference between good ozone and bad ozone? Please include the locations in the atmosphere.
- 3) What are the causes of bad ozone in the troposphere?
- 4) How does high concentration of ozone in the lower atmosphere (troposphere) affect life on Earth?
- 5) Where is most ozone located and what's the benefit?

6) How does NASA collect the ozone data and why?

This will assist them in the next stage of the lesson because the video will help the students understand about ozone and the importance of analyzing the ozone data before they explore more information about the ozone hole over Antarctica.

**Explore:**

The students will learn about the ozone hole, a Dobson unit and view ozone images from the NASA Ozone Watch website:

[https://ozonewatch.gsfc.nasa.gov/facts/hole\\_SH.html](https://ozonewatch.gsfc.nasa.gov/facts/hole_SH.html)

<https://ozonewatch.gsfc.nasa.gov/monthly/SH.html>

[https://ozonewatch.gsfc.nasa.gov/facts/dobson\\_SH.html](https://ozonewatch.gsfc.nasa.gov/facts/dobson_SH.html)

Students will analyze ozone hole data from 1979 to 2020:

[https://ozonewatch.gsfc.nasa.gov/meteorology/figures/ozone/to3area\\_0907-1013\\_toms+omi+omps.txt](https://ozonewatch.gsfc.nasa.gov/meteorology/figures/ozone/to3area_0907-1013_toms+omi+omps.txt)

Students demonstrate that they learned that the stratospheric ozone is getting thinner by analyzing the area of ozone hole data from 1979 to 2020. They will sample the data and find the average (mean) of ozone hole areas from 1979 to 1989 and the average (mean) of ozone hole areas from 2010 to 2020. They will also identify any outlier(s) of the data set.

They will answer the following questions:

- 1) What is the ozone hole?
- 2) What is a Dobson unit?
- 3) During what months does the ozone hole appear and disappear?
- 4) What is the mean ozone hole area from 1979 to 1989? Show your work and don't forget the unit.
- 5) What is the mean ozone hole area from 2010 to 2020? Show your work and don't forget the unit.
- 6) Are there any outlier(s) in the data set during these time frames?
- 7) Why did the ozone hole appear to be smaller in 2019?

Students will learn why the hole was unusually smaller in 2019 (outlier of the data set) by watching this NASA video:

<https://www.youtube.com/watch?v=nnjbvf12pfU&feature=youtu.be>

This will assist them in the next stage of the lesson because the students will be able to explain if the ozone hole is growing based on their investigations.

**Explain:**

Students demonstrate they learned about the ozone hole and that the Earth's ozone has depleted by comparing the average (mean) of the ozone hole areas from 1979 to 1989 and 2010 to 2020, then explain their findings based on their calculations. They will be able to explain the reasons for a smaller area of ozone hole in 2019. They will also explain the effects that a thin layer of stratospheric ozone has on life on Earth.

They will answer the following questions:

- 1) How did the area of the ozone hole from 1979 to 1989 compare to the area from 2010 to 2020?
- 2) What are the causes of the depleting ozone layer in the stratosphere?
- 3) How does a thin layer of stratospheric ozone affect life on Earth?

This will assist them in the next stage of the lesson because the students will be able to extend their knowledge about how human activities influence Earth's ozone and what humans can do to protect Earth's ozone.

**Elaborate:**

Students demonstrate they learned human activities influence Earth's ozone and what they can do to protect Earth's atmosphere by answering the following questions.

- 1) How do human activities influence Earth's ozone?
- 2) What can humans do to protect Earth's atmosphere at the stratospheric and tropospheric levels?

**Evaluate:**

Formative assessment: We will have discussions after the students complete the questions in each stage of the lesson plan. I teach in a virtual classroom called Blackboard Collaborate. They will work collaboratively in groups in the breakout rooms and I will move from one breakout room to another to monitor their progress. I will pull them back into the main room to have the class discussion. Students will answer questions through polling, chat or microphone during formative assessments. Their answers will help determine if the students are moving in the right direction before moving on to the next stage of the lesson plan.

Summative assessment: The assessment rubric is used to evaluate each student's understanding of the phenomena and to hold each student accountable that they are completing the worksheet.

**Content:** To measure the students' understanding of the purpose of collecting and analyzing ozone data using the satellites.

**Application:** To measure the students' understanding of the reasons and impacts of depleting ozone and what they can do to help Earth's ozone.

**Accuracy:** To measure if they calculate the means of the data set accurately and are able to identify any outlier(s).

**Completion:** To make sure that students are completing all components of the worksheet.

**Time:** To help students stay on task and complete their assignments on time.

**STANDARDS:****NGSS:**MS-ESS3-5. Students who demonstrate understanding can:

Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric

levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.

Science and Engineering Practices:

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models.

Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5)

Disciplinary Core Ideas:

ESS3.D: Global Climate Change

Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

Cross Cutting Concepts:

Stability and Change

Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

**Common Core:**

**7<sup>th</sup> Grade Math Standards:**

- Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations (CCCS:7. SP.4)

**7<sup>th</sup> Grade ELA Standard 1: Oral Expression and Listening, Standard 2: Reading for All Purposes & Standard 3: Writing and Composition.**

- Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. (CCSS: SL.7.1)
- Engage in a wide range of nonfiction and real-life reading experiences to solve problems, judge the quality of ideas, or complete daily tasks.



- f. How does NASA collect the ozone data and why?

**Collaboration/Discussion time: Share your response with the class.**

- 2) Explore this NASA Ozone Watch website to learn about the ozone hole and Dobson units.

[https://ozonewatch.gsfc.nasa.gov/facts/hole\\_SH.html](https://ozonewatch.gsfc.nasa.gov/facts/hole_SH.html)

<https://ozonewatch.gsfc.nasa.gov/monthly/SH.html>

Click on this link to view images of the ozone holes at different time frames.

[https://ozonewatch.gsfc.nasa.gov/facts/dobson\\_SH.html](https://ozonewatch.gsfc.nasa.gov/facts/dobson_SH.html)

- a) What is the ozone hole?
- b) What is a Dobson unit?
- c) During what months does the ozone hole appear and disappear?

- 3) The link below contains data of ozone hole areas in square kilometers from 1979 to 2020:

[https://ozonewatch.gsfc.nasa.gov/meteorology/figures/ozone/to3area\\_0907-1013\\_toms+omi+omps.txt](https://ozonewatch.gsfc.nasa.gov/meteorology/figures/ozone/to3area_0907-1013_toms+omi+omps.txt)

- a) What is the mean ozone hole area from 1979 to 1989? Show your work and don't forget the unit.

b) What is the mean ozone hole area from 2010 to 2020? Show your work and don't forget the unit.

c) Are there any outlier(s) in the data set during these time frames?

Please view this video to learn more about the ozone hole in 2019:

<https://www.youtube.com/watch?v=nnjbvf12pfU&feature=youtu.be>

d) Why did the ozone hole appear to be smaller in 2019?

**Collaboration/Discussion time: Share your response with the class.**

4) How did the area of the ozone hole from 1979 to 1989 compare to the area from 2010 to 2020?

5) What are the causes of the depleting ozone layer in the stratosphere?

6) How does a thin layer of stratospheric ozone affect life on Earth?

**Collaboration/Discussion time: Share your response with the class.**

7) How do human activities influence Earth's ozone?

8) What can humans do to protect Earth's atmosphere at the stratospheric and tropospheric levels?

**Collaboration/Discussion time: Share your response with the class.**

**Rubric:**

	Exemplary 4	Meets the Standard 3	Approaching 2	Does Not Meet 1
<b>Content</b>	Shows a full understanding of the benefits of collecting and analyzing the ozone data.	Shows a good understanding of the benefits of collecting and analyzing the ozone data.	Shows a basic understanding of the benefits of collecting and analyzing the ozone data.	Does not seem to understand the benefits of collecting and analyzing the ozone data.
<b>Application</b>	Able to list reasons, impacts and at least 5 applications that they can do to reduce bad tropospheric ozone and depleting stratospheric ozone.	Able to list reasons, impacts and 3-4 applications that they can do to reduce bad tropospheric ozone and depleting stratospheric ozone.	Able to list only a few reasons, impacts and 1-2 applications that they can do to reduce bad tropospheric ozone and depleting stratospheric ozone.	Not able to list reasons, impacts and applications that they can do to reduce bad tropospheric ozone and depleting stratospheric ozone.
<b>Accuracy</b>	Set up and find the means and outlier of the data accurately.	Set up and find the means and outlier of the data with minimal errors.	Set up and find the means and outlier of the data with some errors.	Set up and find the means and outlier of the data with too many errors.
<b>Completion</b>	All work assigned is complete.	Most work assigned is complete.	Some work assigned is complete.	Minimal work assigned is complete.
<b>Timeliness</b>	Assignments turned in on time.	Assignments turned in 1 day	Assignments turned in 2 days	Assignments turned in 3 or

		late.	late.	more days late.
--	--	-------	-------	-----------------

### References:

Colorado Department of Education. (2020). 7<sup>th</sup> grade Mathematics Standards.

<http://www.cde.state.co.us/CoMath/StateStandards>

Colorado Department of Education. (2020). 7<sup>th</sup> grade Reading, Writing, and Communicating Standards. <https://www.cde.state.co.us/coreadingwriting/statestandards>

NGSS Lead States. (2013). Next Generation Science Standards: For States, By States.

<https://www.nextgenscience.org/dci-arrangement/ms-ess2-earths-systems>

NASA eClips. (2013, May 14). Real World: Ozone Alerts. <https://www.youtube.com/watch?v=kMzkXPuWHLg&feature=youtu.be>

NASA Goddard. (2019, October 22). Unusual Winds Drive a Small 2019 Ozone Hole.

<https://www.youtube.com/watch?v=nnjbvf12pfU&feature=youtu.be>

Newman, P. A. (2020, October 26). NASA Ozone Watch, Ozone Maps. NASA Goddard Space Flight Center. <https://ozonewatch.gsfc.nasa.gov/monthly/SH.html>

Newman, P. A. (2020, October 26). NASA Ozone Watch, Ozone Hole Area Annual Data.

NASA Goddard Space Flight Center.

[https://ozonewatch.gsfc.nasa.gov/meteorology/figures/ozone/to3areas\\_2020\\_toms+omi+omps.txt](https://ozonewatch.gsfc.nasa.gov/meteorology/figures/ozone/to3areas_2020_toms+omi+omps.txt)

Newman, P. A. (2020, October 26). NASA Ozone Watch, What is a Dobson Unit? NASA Goddard Space Flight Center. [https://ozonewatch.gsfc.nasa.gov/facts/dobson\\_SH.html](https://ozonewatch.gsfc.nasa.gov/facts/dobson_SH.html)