

Heating Up

David Amidon

SCED 547

Summary

In this lesson, students will examine the effects of CO₂ on the atmosphere. Students begin by watching the global atmospheric CO₂ levels on display in NASA's "A Year in the Life of Earth's CO₂" begin to recognize the relationship between the atmosphere and biosphere by comparing it to a "The Changing Colors of our Living Planet" which shows the Earth's ecosystems in their seasonal fluctuations from space. Students will then graph multiple data sets referring to CO₂ levels in the air and examining how they have changed over time. Using the National Geographic "Causes of global warming, explained" website, students will connect CO₂ levels to human actions. This is followed by an investigation into the actual impact of CO₂ in relation to temperature. Students will design a simulation to model this impact and assess their findings. Finally, Students will write a CER statement about what they think is causing climate change, based on the activities in this set of lessons.

Total Time

~5 class periods (40 min each)

Learning Outcomes

Students will be able to:

- explain the relationship between CO₂ levels in the atmosphere and seasonal plant growth.
- graph data sets and relate them to actual phenomena.
- determine how human actions influence carbon dioxide levels in the air.
- describe how CO₂ impacts temperature in the atmosphere.
- create a model to show how CO₂ impacts environments.
- explain, using evidence, how CO₂ is contributing to climate change.

Standards:

See NGSS Matrix attached

Teaching-Learning Plan: The Inquiry 5E Instructional Model

Time	Teacher Does	Student Does
Engage (15 min)	<ul style="list-style-type: none"> ● Show “NASA A Year in the Life of Earth's CO2” https://www.youtube.com/watch?v=x1SgmFa0r04 <ul style="list-style-type: none"> ● Without Sound! ● Lead a discussion <ul style="list-style-type: none"> ● FOCUS QUESTIONS <ul style="list-style-type: none"> ○ What patterns can you see? ○ What do you think you are watching? ● Have students write their thoughts <ul style="list-style-type: none"> ● In journal or share via online program such as formative.com, FlipGrid or Nearpod ● Then - show a clip from “The Changing Colors of our Living Planet” -either from the video beginning at the 1:20 mark, or the animation on the page. https://www.nasa.gov/feature/goddard/2017/the-changing-colors-of-our-living-planet <ul style="list-style-type: none"> ○ Also without sound ● Have students describe any patterns that match the first video <ul style="list-style-type: none"> ● Either in journal or through previous program ● Rewatch both videos with sound on <ul style="list-style-type: none"> ● FINAL REFLECTION <ul style="list-style-type: none"> ○ Have students reflect on how their understanding changed ○ Describe how plant growth and global CO2 are connected ○ Do the CO2 and plant growth patterns match? Why? ○ If the plants take in the CO2, then why do the videos say the levels are rising in the atmosphere? <p>OPTIONAL - if students have 1:1 devices, provide students with links to the videos. Have them attempt to open both videos in separate windows and match the seasons shown.</p>	<p>Students will watch two separate videos, first with sound off and then with sound on.</p> <p>Students will have a journal OR access to an online program to reflect on the videos, describe patterns and make predictions.</p>

<p>Explore (25 min)</p>	<p>GRAPHING DATA</p> <p>Students will be working from data contained in the CO2 GRAPHS FILE. Tabs contain separate data sets.</p> <p>Graphs include</p> <ul style="list-style-type: none"> ● Global CO2 Emissions ● CO2 levels from Ice Core Data ● CO2 data from Mauna Loa <p>Teachers have the option to assign graphs as they wish - graphing all data sets by hand will take much longer than 25 min.</p> <p>Suggested option: Split students into partner groups</p> <ul style="list-style-type: none"> ● Graph CO2 Emissions Data Set on graph paper <ul style="list-style-type: none"> ○ Plot these in a “Stacked Graph” pattern ● Plot the CO2 Ice Core Data from the 25 year set on separate graph paper ● Plot the Mauna Loa Data through a spreadsheet program <p>Ask students to answer Follow Up Questions. This can be completed based on your preference - handwritten, typed, online, etc.</p>	<p><i>Students will be graphing according to teacher preferences.</i></p> <p>Follow Up Questions:</p> <p>What is the general trend of CO2 in the atmosphere?</p> <p>Where do you think the CO2 is coming from? What evidence do you have to support this?</p>
<p>Explain (1 class period)</p>	<ul style="list-style-type: none"> ● Have students visit: National Geographic “Causes of global warming, explained” https://www.nationalgeographic.com/environment/global-warming/global-warming-causes/ ● Have students work through the website and videos by completing a sketchnote activity on the following worksheet: National Geographic: Causes of global warming, explained ● Teachers may give set break points and lead class discussions after each step, or let the students work through the entire activity and follow up at the end. 	<p><i>Students will generate a “Sketchnotes” document to summarize the learning from the National Geographic site.</i></p> <p>Students will complete the worksheet based on National Geographic: Causes of global warming, explained</p> <p>Using colored pencils, students will illustrate their understandings and add terms that will help them make sense of the material. Additional notes/ sketches will be added after reading new materials or watching new videos.</p>

Elaborate
(1-2 class periods)

Simulating increasing CO2 levels

- Using Antacid Tablets, Water Bottles and a light source, students will create a model to demonstrate how increasing CO2 levels will impact an environment.
- Show the following video to demonstrate <https://www.youtube.com/watch?v=kwt51gvaJQ>. It is intended for a teacher to view - so showing the class from :30 - 2:30 would be sufficient.
- Break the students into groups. Have them design & plan a model to show how CO2 would impact an environment. They will also create a Prediction/ Post-Analysis Poster where they will draw a diagram of their set up, including labels and inputs. Then they will predict what they should see when they begin the simulation.
- Following the simulation, they should draw a second diagram outlining what did happen with labeled drawings. They should also write a conclusion explaining how their model did or did not perform up to expectations.

Suggested poster layout:

PREDICTION	POST ANALYSIS
LABELED DRAWING	LABELED DRAWING
Justification	Data collected Conclusion

- Minimal Materials Needed
 - 2 Liter Bottles
 - Antacid Tabs
 - Light Source
 - Method for measuring temp

Additional materials would be added based on what the teacher is allowing to be included in the model.

Students will be designing their own model of Earth to show how CO2 impacts temperature.

Directions for students:

Watch the video demonstrating how antacid tablets can be used to simulate how CO2 can impact temperatures.

As a group, develop a plan to use the provided materials and create a simulation that will demonstrate how CO2 levels have impacted temperatures on Earth's surface.

Prepare a labeled drawing showing how you will set up your model. Include this on a poster where you will also include a prediction about what will happen with a justification of your thoughts based on evidence.

Run your simulation, making detailed observations and collecting data.

Add on to your poster for the Post-Analysis. Include a labeled drawing indicating what happened, a data table (and graph if applicable), and a conclusion assessing how accurately your model ran compared to your prediction.

Be prepared to share your findings with the class.

	<p>Teachers may ask the students to create a video instead of the poster.</p> <p>Teachers may need to guide groups if they can not determine what they want to set up - groups may want to see the impacts of different amounts of CO2 (antacid tabs) or setting up their own controlled experiments to determine if CO2 has an impact on temperature.</p>	
<p>Evaluate (20 min)</p>	<ul style="list-style-type: none"> Students will write a CLAIM-EVIDENCE-REASONING statement in response to the following prompt: <i>Despite what you may hear in the news, data strongly supports the notion that we are experiencing global climate changes.</i> Based on the activities we have completed, what do <u>you</u> think is causing Climate Change? <p>Based on our investigations, write a CER statement explaining what you think is causing Climate Change. Include at least three pieces of evidence from our class activities to support your claim and write a minimum of two paragraphs supporting your reasoning. You need to directly reference each of our activities at least once.</p> <p>Example shown from NASA Climate Time Machine https://climate.nasa.gov/interactives/climate-time-machine</p> <p>CER Statement will be assessed with the Climate Change CER Rubric, adapted from the NSTA Website (https://learningcenter.nsta.org/mylibrary/collection.aspx?id=GBdqFKABrOU_E).</p>	<p><i>Groups will be provided the Climate Change CER Statement & Rubric worksheet.</i></p> <p>Students will incorporate their new knowledge into a Claim-Evidence-Reasoning Statement based on the prompt and rubric shared on the Climate Change CER Statement & Rubric worksheet.</p>

Sources & References

- Borden, T., & Andres, B. (2017, March 3). *Global CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2014*. Retrieved from https://cdiac.ess-dive.lbl.gov/ftp/ndp030/global.1751_2014.ems
- *Causes of Global Warming*. (2019, February 27). Retrieved from <https://www.nationalgeographic.com/environment/global-warming/global-warming-causes/>

- Christensen, E. (2011, June 13). *The Greenhouse Gas Demo*. Retrieved from <https://www.youtube.com/watch?v=kwtt51gvaJQ>
- Etheridge, D. M. (n.d.). *Historical CO2 record from the Law Dome DE08, DE08-2, and DSS ice cores*. Retrieved from <https://cdiac.ess-dive.lbl.gov/ftp/trends/co2/lawdome.combined.dat>
- Garner, R. (2017, November 13). *The Changing Colors of our Living Planet*. Retrieved from <https://www.nasa.gov/feature/goddard/2017/the-changing-colors-of-our-living-planet>
- Goddard, (2014, November 17). *NASA | A Year in the Life of Earth's CO2*. Retrieved from <https://www.youtube.com/watch?v=xISgmFa0r04>
- *Interactives – Climate Change: Vital Signs of the Planet*. (n.d.). Retrieved from <https://climate.nasa.gov/interactives/climate-time-machine>
- Keeling, R. F., Walker, S. J., Piper, S. C., & Bollenbacher, A. F. (n.d.). *Atmospheric CO2 Data Primary Mauna Loa CO2 Record*. Retrieved from http://scrippsco2.ucsd.edu/data/atmospheric_co2/primary_mlo_co2_record
- NSTA Learning Center. (n.d.). Retrieved from <https://learningcenter.nsta.org/mylibrary/collection.aspx?id=GBdqFKABr0U>