Exploring the Atmosphere's Role in Climate Change

***Grade**: 8th Grade*

***Subject**: Earth Science*

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BIG IDEAS

This lesson focuses on understanding how the atmosphere influences climate change through the analysis of NASA data on CO2 levels and global temperature trends. Students will explore how human activities contribute to rising CO2 levels and how this leads to feedback loops that accelerate global warming.

EDUCATION STANDARDS

HS-ESS2-2: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

NGSS Performance Expectation(s)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.	**ESS2.A: Earth Materials and Systems** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. ***Connections to Engineering,Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Common Core State Standards Connections:

ELA/Literacy -

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-ESS2-2)*

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. *(HS-ESS2-2)*

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-ESS2-2)

HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS2-2)

HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-2)

MEASURABLE STUDENT LEARNING OBJECTIVES

Students will analyze NASA's CO2 and temperature data to identify trends in atmospheric changes.

Students will explain how human activities contribute to climate change based on real-time NASA data.

Students will simulate the effects of increased CO2 on temperature and explain its impact on the atmosphere.

STEM INTEGRATION

Science: Students will engage in data analysis using NASA climate data and conduct a hands-on greenhouse effect simulation to explore the connection between CO2 and global temperature changes.

Math: Students will graph CO2 levels and temperature trends over time, interpreting real-world data through equations and patterns.

Technology: Students will utilize NASA's online climate resources to explore real-time data and gain insights into the role of technology in tracking climate change.

NATURE OF STEM

The nature of STEM integrates science, technology, engineering, and math to explore climate change. Science focuses on atmospheric and cryospheric processes, such as the greenhouse effect and ice melting. Technology is used for analyzing real-time NASA data, enhancing scientific understanding. Engineering is applied in designing hands-on experiments that simulate Earth's systems. Mathematics involves data graphing and analysis to interpret trends.

MATERIALS NEEDED

Computers/tablets with internet access

NASA Climate Change website: (https://science.nasa.gov/climate-change/evidence/)

NASA Global Maps website: (https://earthobservatory.nasa.gov/global-maps/MOD_LSTD_M)

NOAA CO2 Levels Website: (https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide)

Jars, water, thermometers, baking soda, vinegar (for greenhouse simulation)

Student handouts with guided questions

ENGAGING CONTEXT/PHENOMENON

The lesson begins with a discussion and exploration of NASA data showing rising CO2 levels, connecting this with how the atmosphere plays a key role in climate change. The

hands-on simulation will allow students to observe how increased CO2 contributes to temperature rise, illustrating the greenhouse effect.

DATA INTEGRATION

Students will use NASA's real-time CO2 and temperature data to observe trends and connect human activities to climate change. The data will be analyzed through graphing, and the simulation will further reinforce their understanding of how these factors are linked.

TEACHER BACKGROUND KNOWLEDGE

Teachers should have a foundational understanding of the greenhouse effect, the role of CO2 in climate change, and how to use NASA's climate data tools. Familiarity with the concepts of feedback loops and global temperature trends will be helpful.

DIFFERENTIATION OF INSTRUCTION

Provide simplified graphs and datasets for students who need additional support. Pair struggling students with peers for the hands-on simulation to foster collaboration. Use visual aids and sentence starters for students needing additional help with reflections.

REAL-WORLD CONNECTIONS FOR STUDENTS

Students will learn how human activities like burning fossil fuels contribute to rising CO2 levels and how this connects to climate change, giving them a real-world perspective on how their actions affect the planet.

INTEGRATION POSSIBLE MISCONCEPTIONS

Students may believe that only natural processes cause climate change.

Some students may not understand how small changes in CO2 levels can have significant impacts on global temperatures.

LESSON PROCEDURE

5E	Details of 5E Lesson Implementation
Engage	**Procedure**: Show an interactive graph of rising CO2 levels and ask students how human activities might contribute. **Modifications**: Visuals and simplified language for students who need additional support. **Standards: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. **Formative Assessment**: Assess student responses. **Resources**: https://science.nasa.gov/climate-change/evidence/
Explore	**Procedure**: Students will work in pairs to analyze real-time data and graph CO2 levels vs. temperature changes. **Modifications**: Provide guided questions to stimulate discussion. **Standards: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. **Formative Assessment**: Assess student understanding based on responses. **Resources**: https://science.nasa.gov/climate-change/evidence/

Explain	**Procedure:** Facilitate a discussion where students explain their findings and connect CO2 levels with temperature rise. **Modifications:** Provide clear examples of feedback loops. **Standards: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. **Formative Assessment:** Check for understanding during the discussion. **Resources:** https://science.nasa.gov/climate-change/evidence/ https://earthobservatory.nasa.gov/global-maps/MOD_LSTD_M https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide
Elaborate	**Procedure**: Hands-on greenhouse simulation using jars, thermometers, and CO2 sources (baking soda and vinegar). **Modifications**: Heterogeneous pairing for additional support during the experiment. **Standards: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. **Formative Assessment**: Monitor students during the simulation and assess their observations. **Resources**: Jars, thermometers, baking soda, vinegar. **Worksheet: Carbon Dioxide and Air Temperature**

Evaluate	**Procedure**: Students write a reflection on how NASA's data and the greenhouse simulation deepened their understanding of climate change. **Modifications**: Use sentence starters for students needing help with reflections. **Standards: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. **Summative Assessment**: Collect written reflections for evaluation. **Resources**: CO2 Data Analysis Worksheet - Atmosphere Lesson

REFERENCES

https://science.nasa.gov/climate-change/evidence/

https://earthobservatory.nasa.gov/global-maps/MOD_LSTD_M

https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide