Endeavor
STEM Teaching Certificate Project

Exploring the Atmosphere's Role in Climate Change

***Grade**: 8th Grade*

***Subject**: Earth Science*

***Duration**: 90 Minutes*

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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, Sea Ice, 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.

MATERIALS NEEDED

Computers/tablets with internet access

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

Student handouts with guided questions

Important Links:
https://eyes.nasa.gov/apps/earth/#/vital-signs/carbon-dioxide/oco-2-carbon-observatory-16day

https://eyes.nasa.gov/apps/earth/#/vital-signs/air-temperature/airs-infrared-surface-3day

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

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

https://mynasadata.larc.nasa.gov/

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	**Lesson Objective:** Students will analyze NASA's CO2, Arctic Ice, and temperature data to identify trends in atmospheric changes. **Standards: HS-ESS2-2**: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that causes changes to other Earth systems.

	Resources: **2018 Arctic Sea Ice Ties for Sixth Lowest Minimum Extent ..** **Lesson Procedure**: Show video of Arctic Sea Ice Ties for Sixth Lowest Minimum Extent on NASA Record. Ask students to describe the overall trend of Arctic Sea Ice from 1980 to 2015. **Formative Assessment**: Assess student responses. **Modifications**: Visuals and simplified language for students who need additional support.
Explore	**Lesson Objective:** Students will analyze NASA's CO2, Arctic Ice, and temperature data to identify trends in atmospheric changes. **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. **Materials and Resources**: https://mynasadata.larc.nasa.gov/ Yearly Snow and Ice Extent **Lesson Procedure**: Students will work in pairs to analyze real NASA data of yearly snow and ice cover from 2001 to 2022 to describe the trend in percentage in snow and ice cover. Data retrieved from My NASA Data. **Formative Assessment**: Assess student understanding based on responses. **Modifications**: Provide guided questions to stimulate discussion.

Explain	**Lesson Objective:** Students will analyze NASA's CO2, Arctic Ice, and temperature data to identify trends in atmospheric changes. **Standards: HS-ESS2-2**: Analyze NASA data to make the claim that one change to Earth's surface can create feedbacks that causes changes to other Earth systems. **Materials and Resources:** https://eyes.nasa.gov/apps/earth/#/vital-signs/carbon-dioxide/oco-2-carbon-observatory-16day https://eyes.nasa.gov/apps/earth/#/vital-signs/air-temperature/airs-infrared-surface-3day **Lesson Procedure:** Facilitate a discussion where students explain their findings and connect CO2 levels with air temperature. **Formative Assessment:** Check for understanding during the discussion. **Modifications:** Provide clear examples of feedback loops.
Elaborate **Day 2**	**Lesson Objective:** Students will simulate the effects of increased CO2 on temperature and explain its impact on the atmosphere. **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. **Lesson Procedure**: Hands-on greenhouse simulation using jars, thermometers, and CO2 sources (baking soda and vinegar). **Materials and Resources**: Jars, thermometers, baking soda, vinegar.

	Carbon Dioxide and Air Temperature **Formative Assessment**: Monitor students during the simulation and assess their observations. **Modifications**: Heterogeneous pairing for additional support during the experiment.
Evaluate	**Lesson Objective:** Students will explain how human activities contribute to climate change based on real-time NASA data. **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. **Procedure**: Students write a reflection on how NASA's data and the greenhouse simulation deepened their understanding of climate change. **Materials and Resources**: CO2 Data Analysis Worksheet - Atmosphere Lesson **Summative Assessment**: Collect written reflections for evaluation. **Modifications**: Use sentence starters for students needing help with reflections.

REFERENCES

https://eyes.nasa.gov/apps/earth/#/vital-signs/carbon-dioxide/oco-2-carbon-observatory-16day

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

on-dioxide

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