

Connecting to Climate Change

5 E Lesson Plan

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Lesson/Activity Title: Connecting to Climate Change

Recommended Age(s)/Grade(s): 11-12th grade

Subjects-Science, Math, and Technology

Time Needed - Preparation: 1 hour total

Time Needed - Execution: 10 (50 minute) class periods

This unit will allow students to deepen their awareness of the world and other people and see issues, problems and solutions on a global scale. They will learn about the global issue of climate change and how it is impacting a variety of ecosystems and communities around the world.

They will assume responsibility for personal and collective contributions to the reduction of and solution to current problems in the environment. Students will learn that humans have contributed to a rise in carbon dioxide levels since the industrial revolution which is directly impacting our global climate. They will understand the importance of taking action to reduce our usage of carbon dioxide. Students will also take positive action in designing plans for addressing issues of interest on a local or global level. Students will actively seek ways in which communities can mitigate responses to climate change impacts in various communities around the world.

Nebraska College and Career Ready Standards:

- SC.HS.12.2 Gather, analyze, and communicate evidence to support that Earth's climate and weather are influenced by energy flow through Earth systems
- SC.HSP.4.2.C Analyze and interpret data to explain changes in energy within a system and/or energy flows in and out of a system.
- SC.HSP.4.2.D Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- SC.HS.15.5 Gather, analyze, and communicate evidence to describe the interactions between society, environment, and economy

Objectives:

By the end of this lesson, students will be able to:

- Understand the Greenhouse Effect and how it contributes to global warming.
- Explain how the Greenhouse Effect impacts global climate.
- Hypothesize about the effects of climate change on the environment.
- Understand how carbon dioxide concentrations relate to climate change.
- Utilize the internet to research a variety of a changing climate on a particular ecosystem
- Analyze data and variables
- Determine solutions to local issues relating to climate change

Materials and Preparation Needed:

- Know-Want to Know-Learned (KWL) worksheet for each student
- Computers or devices with Google Spreadsheets or Excel and internet access

- Data Spreadsheets (Carbon dioxide,
- Two graduated cylinders for each group of students
- ice
- one funnel for each group
- Materials (paper, poster board, etc) for presentations as chosen by students

Procedure:

**Day 1 and Day 4 are adapted from the National Geographic activity 'Climate Change and Rising Seas' found at <https://www.nationalgeographic.org/activity/climate-change-and-rising-seas/>.*

Day 1:

Engage

1. Begin by asking students a question about the local climate. For example, "What's causing the warmer summers and historic flooding in our region." Ask students to provide possible explanations for these changes.
2. Ask students to fill out the 'Know' section on their KWL worksheet regarding Climate Change. Allow students to share their responses in order to gauge any misconceptions about climate change. Ask students to fill out the 'Want to Know' section on their worksheets and have them share those with others.

Standards: SC.HS.15.5 Gather, analyze, and communicate evidence to describe the interactions between society, environment, and economy

Modification: Give students several pictures as a prompt. For example, pictures of flooded agricultural fields, melting glaciers, etc. and ask them to tell what they might know about those images.

Assessment: Teacher will use formative assessment by gauging understanding during time students are sharing out their responses on their KWL worksheet.

Resources: Know, Want to Know, Learned worksheet copies for each student.

Explore

3. Have students complete a webquest to answer the following questions and tasks:
 - a. What is climate and weather?
 - b. In your opinion, is climate change a problem?
 - c. What is a greenhouse gas? What is the greenhouse effect? How do they relate to climate change?
 - d. What is the main greenhouse gas humans have been releasing into the atmosphere since the industrial revolution?
4. Watch the CNN video 'Undeniable Climate Change Facts' at <https://www.cnn.com/videos/weather/2018/01/18/nasa-climate-change-report-2018-gray-orig-js.cnn> and answer the following regarding the video
 - a. What is important about the months prior to September 2016?
 - b. How much have sea levels risen since July 2016?
 - c. How much have carbon dioxide levels risen since the 1950's?
 - d. Do all scientists agree that climate change is indeed happening?
5. Have students find and submit one image of climate change. Why did you choose this image? How does it relate to climate change?

Day 2:

1. Students will be using a free interactive lesson from Concord Consortium for STEM resources. Tell students that this interactive uses data from NASA and NOAA. Students will complete the 'What is the future of Earth's climates?' activity on <https://authoring.concord.org/sequences/388/activities/7665/pages/100061/a2bf3e1e-1e46-47c5-ac5a-0e6e2e58355a>. They will analyze the graphs and interactives and answer the questions as they go.

Standards:

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SC.HSP.4.2.D Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

SC.HS.15.5 Gather, analyze, and communicate evidence to describe the interactions between society, environment, and economy

Modification: This lesson could also be modified by given more direct instruction to students regarding greenhouse gases, climate change, and impacts to ecosystems.

Assessment: Student responses to questions from Day 1 will be discussed as a group and individual answers will be collected. Student responses to questions from Day 2 will be collected and assessed for understanding.

Resources:

<https://www.cnn.com/videos/weather/2018/01/18/nasa-climate-change-report-2018-gray-orig-js.cnn>

<https://authoring.concord.org/sequences/388/activities/7665/pages/100061/a2bf3e1e-1e46-47c5-ac5a-0e6e2e58355a>.

Explain

Day 3:

1. Students will construct graphs with real data and analyze different variable contributing to climate change. Students will use Google Spreadsheets or Excel and the data from various sources to create graphs that represent the following:
 - a. Carbon Dioxide (CO₂) over time (1959-2014) www.co2.earth/historical-co2-datasets
 - b. Temperature over time. www.ncdc.noaa.gov/cag/global/time-series
 - c. Ocean pH over time. www.oceanacidification.noaa.gov/WhatWeDo/Data.aspx
 - d. Oil Equivalent Usage over time www.worldbank.org/indicator/EG.USE.PCAP.KG.OE
2. Students will then take each variable and relate it to the other three and look for connections in the data by answering the following questions in a write up:
 - a. How does CO₂ relate to temperature, ocean pH, and oil equivalent?
 - b. How does Temperature relate to CO₂, ocean pH and oil equivalent?
 - c. How does Ocean pH relate to CO₂, temperature, and oil equivalent?
 - d. How does Oil Equivalent relate to CO₂, temperature, and ocean pH?

3. Ask the students how the data they analyzed relates to climate change?

Standards:

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SC.HS.15.5 Gather, analyze, and communicate evidence to describe the interactions between society, environment, and economy

Modification: This lesson could be adapted by eliminating some of the graphing work for students. Students can be given the graphs and allowed to analyze each variable without having to create them.

Assessment: Student graphs and related questions will be analyzed by the teacher to determine if appropriate connections were made.

Resources:

www.co2.earth/historical-co2-datasets

www.ncdc.noaa.gov/cag/global/time-series

www.oceanacidification.noaa.gov/WhatWeDo/Data.aspx

www.worldbank.org/indicator/EG.USE.PCAP.KG.OE

Explore and Explain

Day 4:

1. Students will examine the question, “Will melting ice cause a rise in sea level?” Have students watch the following video: <https://www.nbcnews.com/nightly-news/video/climate-in-crisis-lester-holt-s-journey-to-alaska-69085765639>
2. Discuss the video and the observations of Lester Holt in Alaska. Ask students to think about the effects of this melting. Will it cause our ocean levels to rise? What about sea ice?
3. Break students into small groups. Provide each group with two 100 mL graduated cylinders, water, one funnel, and ice. Have them put ice into one of the graduated cylinders and measure and record the volume of water before and after the ice melts. In the second cylinder, have students place the funnel on top of the cylinder and fill it with the same amount of ice. Have them measure and record the volume of water before and after the ice melts. Have them answer the following questions:
 - a. *In which situation did the water level rise more? (“Ice on Land” container)*
 - b. *How do the results compare with your predictions?*
 - c. *Why do you think this happened? (When ice cubes sitting on the funnel melt, the water runs off and adds to the volume of water in the “ocean.” Conversely, floating ice is already taking up space in the water—displacing a mass of water that is equivalent to the mass of the ice. When the ice melts, the water fills that existing space. Make sure students don't confuse this with rising sea level that results from water expanding as it warms. This experiment only deals with the result of melting land ice.*
4. Have students watch and discuss the National Geographic video ‘Why Melting Glaciers Matter to the Coasts’ at: <https://www.nationalgeographic.org/media/why-melting-glaciers-matter-coasts/>

Standards:

SC.HSP.4.2.C Analyze and interpret data to explain changes in energy within a system and/or energy flows in and out of a system.

Modification: This lesson could also be modified by given more direct instruction to students regarding sea level rise, glacial and sea ice melt, and increasing global temperatures.

Assessment: Questions answered during the lab will be utilized by the teacher.

Resources:

<https://www.nbcnews.com/nightly-news/video/climate-in-crisis-lester-holt-s-journey-to-alaska-69085765639>

<https://www.nationalgeographic.org/media/why-melting-glaciers-matter-coasts/>

Elaborate

Day 5-10

1. For their final project on Climate Change, students will act as City Council members of an assigned community. They will research and present major risks faced to the community and suggest promising plans for adaptation to climate change. Students will present to guests (other students, adults, teachers, staff etc) invited by the teacher. The guests will ask questions to better understand the assigned community and the plans for mitigating climate change impacts. Students may present in any way they choose (posters, flyers, Google Slide, video) but should include details outlined in the rubric. The following topics should be covered:
 - a. local/regional climate changes including temperature and precipitation patterns;
 - b. impacts to the food supply, changes to crop yields;
 - c. impacts to freshwater supply;
 - d. regional ecological changes (plant and animal communities);
 - e. health concerns, including insect borne diseases and other concerns;
 - f. impacts to the local/regional economy;
 - g. concerns with power supply;
 - h. and any other societal concerns.

Standards:

SC.HSP.4.2.D Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

SC.HS.15.5 Gather, analyze, and communicate evidence to describe the interactions between society, environment, and economy

Modification: Students would not have to present their final presentation to an audience. They could also present them to their peers rather than community members. Students could choose to make a PSA or video presentation as an alternate delivery method. An extension of this unit could include analyzing the local environment to determine specific impacts on the student's community and suggesting solutions to mitigate impacts. Additionally, students could take more action on climate change by writing their local representatives to suggest solutions to these issues.

Assessment *For their final presentations, the following rubric is used:*

<https://docs.google.com/document/d/10eS-yYlrKd6HnMSjGAeBK7xvzfB2NEI3OkCP38-uvY/edit?usp=sharing>

Resources:

No additional resources needed for this portion of the lesson.

Evaluate

Standards:

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Modification: Student oral responses will also be used as a way to gauge understanding through the unit. Students may submit alternate assignments throughout as a way to express

Assessment:

Students will be assessed using the questions they are asked throughout the unit. They will also be assessed for understanding in conversations and class discussions throughout the unit.

For their final presentations, the following rubric is used:

<https://docs.google.com/document/d/10eS-yYlrKd6HnMSjGAeBK7xvzfB2NEI3OkCP38-uvY/edit?usp=sharing>

Students will be assessed on their understanding of the following vocabulary: climate change, greenhouse gas, greenhouse effect, sea ice, land based ice.

The following connections should be made by the students:

Students will consider historical perspectives when analyzing data throughout the lesson.

Students will consider cultural and political perspectives when they analyze how to come up with solutions to local issues relating to climate change.

Students will consider many ecological perspectives as they look at climate change impacts to communities and ecosystems.

Students will analyze how humans can both positively and negatively impact their local and regional environment, which can have larger global implications.

Teacher Background and Additional Resources:

The teacher should have background knowledge of both the greenhouse effect and climate change. The teacher should also understand how the different variables discussed in this lesson (carbon dioxide levels, sea level rise, temperature increase, ocean pH fluctuations) can impact humans.

STEM Resource Finder

<https://learn.concord.org/>

Teach with Fergy for ideas for webquests and data collection.

<https://teachwithfergy.com/>

Interactives and information from NASA:

https://climate.nasa.gov/climate_resource_center/interactives