



Confronting the Climate Crisis

OVERVIEW

ESSENTIAL QUESTION

How can society lower the amount of greenhouse gases released into the atmosphere?

OVERVIEW

On October 2018, the United Nations' Intergovernmental Panel on Climate Change (IPCC) released a report outlining the impacts of a global climate 1.5° Celsius warmer than pre-industrial levels. The scientific predictions were bleak, describing the possibility of large-scale droughts, famine, loss of ecosystems, species die-off, and the decline of habitable land resulting in mass climate migrations. Even more startling, IPCC scientists reported that even limiting warming to 1.5° Celsius would require “rapid and far-reaching transitions in energy, land, infrastructure, and industrial systems” that are possible but “unprecedented.”



Photo: Mass Communication Specialist 2nd Class Daniel Barker

Scientists since the 1960s have known that the emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide trap heat in Earth's atmosphere, warming the planet. Such gases are primarily emitted through the burning of fossil fuels such as oil, coal, and natural gas. But given the importance of such fuels in the global economy, there has been little effort to curb their use. In fact, some of the first institutions to become aware of the dangers of greenhouse gases were fossil fuel companies themselves, who spent billions of dollars shielding their findings from the public.

In part thanks to the publication of the 2018 IPCC report, the danger greenhouse gases pose to the planet is no longer a secret. 97% of scientists agree that climate change is caused by human actions. Just one hundred (mostly fossil fuel) companies are responsible for 71% of all greenhouse gas emissions. These companies, furthermore, are financed by the largest financial institutions in the world, such as JPMorgan Chase, Citigroup, and BlackRock.

Thankfully, people across the globe are taking action. Research institutes are developing climate pathway models that keep global warming below 1.5 ° Celsius. In 2019, 48 cities in the United States have taken action towards curbing greenhouse gas emissions, and states like California, Colorado, Maine, Nevada, New Mexico, New York and Washington have enacted legislation aimed at getting 100% of their energy from clean, renewable sources. At the federal level, the idea of a “Green New Deal”—a countrywide, climate-focused federal works program—is gaining publicity. In the private sector, the number of Fortune 500 companies to set 100% renewable energy targets have doubled since 2017.

Much of these efforts have been accelerated thanks to pressure from a myriad of environmental activist movements - many of which have been spearheaded by teenagers and young adults. In Europe, Greta Thunberg almost single-handedly initiated a series of global student strikes to demand that the emission of greenhouse gases is addressed by governments internationally. In the United States, 16 year old Isra Hirsi serves as one of the co-directors and co-founders of the US Climate Strike, an organization formed in solidarity of Thunberg's efforts. Hirsi has used her activism to focus on the intersection of climate change, race, and socioeconomic background.

The ongoing climate emergency has also been addressed by musicians. Climate change has become a prominent theme in the work of Bon Iver, The 1975, Lil Dicky, Mitski, and Grimes. In September 2019, chart topping artist Billie Eilish released the music video for the environmentally-minded song, "All the Good Girls Go To Hell." The video features a winged Eilish stumbling out of an oil spill while the surrounding landscape is engulfed in flames. In announcing the video, Eilish framed such apocalyptic imagery as a warning and call to action, urging her millions of social media followers to join in the global climate strikes first initiated by Thunberg.

Throughout this lesson, students will conduct a simple experiment to examine how greenhouse gases trap heat. They also discuss the ways the Billie Eilish song and music video "All Good Girls Go to Hell" addresses environmental concerns, and evaluate various possible climate pathways through a creative writing exercise. Finally, they reflect on ways they might be able to contribute to the fight for a healthy climate and environment by drafting a climate action plan.

MATERIALS REQUIRED:

- Two empty 2-liter bottles
- 3 Alka-Seltzer tablets
- A heat lamp
- 2 temperature sensors or thermometers
- Computers, laptops, Chromebooks, or other devices with internet access

OBJECTIVES

Upon completion of this lesson, students will:

1. KNOW (KNOWLEDGE):

- The cause and effects of global warming
- Pathways to slowing the release of greenhouse gases that cause global warming
- Personal and social actions that might be taken to address the climate crisis
- The artist Billie Eilish, and the way she addresses climate concerns in her song in her song "All Good Girls Go to Hell"

2. MASTERY OBJECTIVE

- Students will be able to identify the causes and effects of global warming and consider pathways to addressing the climate crisis by conducting experiments, examining charts, interacting with climate projections, and analyzing musical examples.

ACTIVITIES

PREPARATION

1. Drill or punch a hole in the top of the bottle caps of the two two-liter bottles, so that the temperature sensor or thermometer can poke through. Alternatively, wrap the lids of the bottles in aluminum foil so that the temperature sensor can puncture the foil cap.
2. Fill each 2 liter bottle halfway with water. Label one bottle “1” and the other “2”.
3. Place both bottles two feet from the heat lamp, in clear view for students, making sure the light shines on the bottles as evenly as possible.
4. Place the two temperature sensors in the bottles, through the bottle cap.
5. On the board, draw a chart with three columns, the first labeled “Time,” the second labeled “Bottle 1,” and the third “Bottle 2.”

MOTIVATIONAL ACTIVITY

1. Tell students that in the class they will be learning about the effect of greenhouse gases in Earth’s atmosphere. Ask students:
 - Have you heard the term “greenhouse gases” before? What are they?
 - What is a greenhouse? How does it work? (*Note to teacher: A greenhouse is a covered enclosure that holds heat, so that the plants within can survive in colder climates.*)
 - Can you name any common greenhouse gases? (*Note to teacher: the most common greenhouse gases are water vapor, carbon dioxide, methane, nitrous oxide and ozone.*)
2. Draw students’ attention to the two bottles of water. Tell them these bottles represent Earth’s atmosphere, and the heat lamp represents the sun. Ask a student volunteer to announce the temperature reading for each bottle, and record the temperature on the appropriate section of the chart, being sure to note the time the temperature was taken (*Note to teacher: for the sake of simplicity, it is recommended that temperature readings are timed exactly on the minute.*)
3. Next, ask a student volunteer to place the three Alka-Seltzer tabs into Bottle 2. Tell students that the tablets will initiate a chemical process that creates carbon dioxide, a greenhouse gas. Make sure the bottle cap is screwed back on, and the temperature meters are positioned correctly.
4. Tell students that throughout the class they will be returning to take the temperature of the bottles.

PROCEDURE:

- Pass out to students **Handout 1 - Billie Eilish, “All The Good Girls Go to Hell” Lyrics**. After giving students time to read the lyrics, ask them:

 - Have you heard this song before? Where?
 - Looking at the lyrics, what do you think this song is about?
 - What kind of imagery is presented in the lyrics?
 - Who is “Peter,” referred to in the long? What about “Lucifer?”
 - Are there any references to actual events in this song? If so, where?
- Display **Image 1, “All Good Girls Go to Hell” Screenshot A, and Image 2, “All Good Girls Go to Hell” Screenshot B**. Ask students:

 - How might the imagery from the music video for “All the Good Girls Go to Hell” add clarity to the meaning of the song?
 - Who is the narrator of this song? Is it a human, or something else? Does it change throughout the song?
 - What might the fire in the video symbolize? What about the oil?
 - In what ways do Eilish’s lyrics alter or reverse more traditionally held notions and ideas? Can you find any specific examples from the text? What might her intent be with these lyrics? Is it to shock? To spur thought?
- Show **Image 3, Interview Excerpt with Finneas O’Connell**. Tell students that the text in the image comes from an interview with Finneas O’Connell, Billie Eilish’s co-producer and brother, from *Vulture.com*. Read the lyrics out loud as a class. Ask students:

 - Does Finneas’ description of the meaning of the song line up with your own analysis?
 - To you, what might some ways the world has become “a mess”? Where do the responsibilities lie for these issues?
 - What might be the overall message of this song? Do you find it more optimistic or pessimistic? Why? Could the song be empowering? In what way?
- Return to the experiment. Ask a student volunteer to record the temperatures on the bottles, and record the results on the chart. Observe and discuss the results with the class (is one bottle getting hotter?)
- Organize students into groups, and provide each group of students with a laptop, Chromebook, or other device that can access the internet. Tell students that 97% of climate scientists believe human-caused greenhouse gas emissions are leading to global warming. Ask them to go to <http://bit.ly/ClimateExplorer>. Ask the class:

 - According to this chart, which 5 countries emit the most greenhouse gases?
 - What percentage does each country emit? (*Note: You can find the exact percentage by rolling the cursor over the country.*)
- Ask each group to choose a country of their choice from the graph, and click on it. Then ask student groups:

- In the country you picked, what sector emits the most greenhouse gases? What percentage of the total does that sector represent?
 - What other sectors contribute to greenhouse gas emissions?
7. After each group has presented, ask students:
 - Based on what each group presented, do you see any patterns? Are the same sectors producing the most greenhouse gas emissions?
 8. Give each group **Handout 2 - Greenhouse Emissions by Sector**. Tell students that the handout represents the sectors that produce the most greenhouse gases internationally. Ask students as a group to brainstorm and try to fill out the rest of the chart using their own knowledge of climate change. For example, in the “Energy” row, “cars” might fall under the “Primary Emitters” column, with “electric cars” falling under the “Cleaner Alternatives” column. (*Note to teacher: an example of a filled out worksheet can be found here: <https://teachrock.org/resources/image/global-greenhouse-gas-emissions-by-sector-example/>*)
 9. Ask student groups to share what they brainstormed on Handout 2.
 10. Return to the experiment. Ask a student volunteer to record the temperatures on the bottles, and record the results on the chart. Observe and discuss the results with the class. Ask students:
 - What kinds of things might happen to the planet if it slowly heats?
 - How might a warming planet affect glaciers and icebergs?
 - How might a warming planet affect the ocean?
 - What sort of natural disasters might a warming planet precipitate?
 - In what ways might people and animals be affected by a warming planet? (*Encourage students to consider the changes in food production, living environment, etc.*)
 11. Tell students that, under the threat of such conditions, many research institutes, scientists, consultancies, and companies have developed various pathways to curb the use of greenhouse gases. A goal for many of these agencies is to keep the globe below 2° Celsius (3.6 degrees Fahrenheit) of warming. After this point, the Intergovernmental Panel on Climate Change (IPCC) warns, the earth will likely experience “substantial species extinctions” and “large risks to global and regional food security” (starvation).
 12. Direct student groups to **<http://tool.globalcalculator.org>**, a site where they can explore various pathways proposed. Display **Image 4 - Global Calculator Screenshot**, and explain each section of the tool:
 - The top yellow section marked “A” shows the various impacts of the selected climate pathway. There are six tabs in all capital letters that are the main categories. Selecting any category presents a variety of subcategories to explore.
 - The middle blue section marked “B” displays the data for the category selected in the “A” section. Sometimes, there will be options to display different types of data in this field, appearing to the left.

- The lower red section marked “C” is where you select or create a climate pathway. For this class, we will only be selecting pre-made pathways in the “Example Pathways” pulldown menu.

13. Pass out a copy of **Handout 3 - A Letter from the Future**. Give student groups time to read the instructions, and draft their letter.
14. Return to the experiment. Ask a student volunteer to record the temperatures on the bottles, and record the results on the chart. Observe and discuss the results with the class (is one bottle getting hotter?)
15. Ask each group to read their letter from the future out loud, without telling the rest of the class which pathway they chose to pursue. Encourage students to take notes on the pertinent aspects of each letter as it is presented. After all groups have presented, ask students:
 - Which letter offers the best vision of the future? (*If necessary, take a vote with a show of hands.*)
 - Which letter offers the worst vision of the future? (*If necessary, take a vote with a show of hands.*)
16. Ask the groups to reveal the pathways they chose to write about.
17. For a final time, ask a student volunteer to record the temperatures on the bottles, and record the results on the chart. Observe and discuss the results with the class. Ask students:
 - Do you notice a change in warming between bottle 1 and bottle 2?
 - What might keep happening if we continue this experiment?
 - What might happen if we continue to add carbon dioxide in one of the bottles?
 - What does this experiment say about the danger of carbon dioxide in Earth’s atmosphere?

SUMMARY ACTIVITY

1. Tell students that to conclude the class will develop within their groups potential climate change action plans in order to achieve the pathway the class determined was the most positive. Have students return to the filled-out versions of **Handout 2 - Greenhouse Emissions by Sector**. Ask them to choose 1-3 items in the column “Primary Emitters” that also have clean alternatives in the column to the right. Ask students to brainstorm what sort of actions are required to transition to cleaner alternatives. Encourage them to differentiate between personal actions and political activism or advocacy.
2. Have students share their action plans with the rest of the class. Then ask students:
 - What sort of actions could help curb greenhouse gas emissions? Are they individual actions, collective actions, or both?

- Many of the industries presented on the handout are financed by multinational financial institutions. What actions might be taken to pressure such institutions to invest less in fossil fuels and more in clean energy companies?

3. Share student's action plans and letters from the future with info@teachrock.org!

EXTENSION ACTIVITIES:

1. **Create your own pathway:** Individually or as a group, use the bottom third of the tool at <http://tool.globalcalculator.org/globcalc.html> to develop your own climate pathway by adjusting the various "levers" at the bottom third of the tool (hint: rolling the mouse over each description next to the levers will give more information about it.) Try to create a pathway that keeps the temperature below 2° Celsius of warming, and eventually leads to net-zero carbon admissions. After creating the pathway, write a short account of the approach you took and what efforts need to be pursued to make the pathway a reality. In what ways might affect future lifestyles?
2. Conduct research on an industry of your choice (transportation, media, fashion, etc.) Summarize the ways this industry contributes to greenhouse gas emissions, and what is being done to curb these emissions within the industry. Do any particular companies stand out as "good" or "bad" actors in this industry? Why?

EXPLORE FURTHER:

- 350.org (www.350.org)
- Fridays for the Future (www.fridaysforthefuture.org)
- Sierra Club (www.sierraclub.org)
- Indigenous Environmental Network (www.ienearth.org)
- Friends of Earth International (www.foei.org)

COMMON CORE STATE STANDARDS

College and Career Readiness Anchor Standards for Reading (K-12)

Reading 1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

Reading 2: Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

Craft and Structure 4: Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

Craft and Structure 6: Assess how point of view or purpose shapes the content and style of a text.

Integration of Knowledge and Ideas 7: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

Integration of Knowledge and Ideas 8: Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

Range of Reading and Level of Text Complexity 10: Read and comprehend complex literary and informational texts independently and proficiently.

College and Career Readiness Anchor Standards for Writing (K-12) (Extension Activities only)

Text Types and Purposes 1: Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.

Text Types and Purposes 2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

Text Types and Purposes 3: Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.

Production and Distribution of Writing 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Research to Build and Present Knowledge 7: Conduct short as well as more sustained

research projects based on focused questions, demonstrating understanding of the subject under investigation.

Research to Build and Present Knowledge 9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

College and Career Readiness Anchor Standards for Language (K-12)

Language 1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

Vocabulary Acquisition and Use 6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

College and Career Readiness Anchor Standards for Speaking and Listening (K-12)

Comprehension & Collaboration 1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Comprehension & Collaboration 2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Comprehension & Collaboration 3: Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

Presentation of Knowledge 4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

NEXT GENERATION SCIENCE STANDARDS (NGSS)

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperature over the past century.

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

MS-ESS3-3: Apply scientific principles to design a method for monitoring or minimizing a human impact on the environment.

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS3-5: Analyze geoscience data and the result from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts of Earth systems.

HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS3-6: Use a computational representation to illustrate the relationship among Earth systems and how those relationships are being modified due to human activity.

NATIONAL CURRICULUM STANDARDS FOR SOCIAL STUDIES – NATIONAL COUNCIL FOR THE SOCIAL STUDIES (NCSS)

Theme 1: Culture

Theme 2: Time, Continuity, and Change

Theme 3: People, Place, and Environments

Theme 5: Individuals, Groups, and Institutions

Theme 6: Power, Authority, and Governance

Theme 7: Production, Distributions, and Consumption

Theme 8: Science, Technology, and Society

Theme 9 : Global Connections

Theme 10: Civic Ideals and Practices

COLLEGE, CAREER & CIVIC LIFE (C3)

Dimension

D4.1.6-8: Construct arguments using claims and evidence from multiple sources, while acknowledging the strengths and limitations of the arguments.

D4.6.6-8: Draw on multiple disciplinary lenses to analyze how a specific problem can manifest itself at local, regional, and global levels over time, identifying its characteristics and causes, and the challenges and opportunities faced by those trying to address the problem.

D4.6.9-12: Use disciplinary and interdisciplinary lenses to understand the characteristics and causes of local, regional, and global problems; instances of such problems in multiple contexts; and challenges and opportunities faced by those trying to address these problems overtime and place.

D4.7.6-8: Assess their individual and collective capacities to take action to address local, regional, and global problems, taking into account a range of possible levers of power, strategies, and potential outcomes.

D4 .7.9-12: Assess options for individual and collective action to address local, regional, and global problems by engaging in self-reflection, strategy identification, and complex causal reasoning.

NATIONAL STANDARDS FOR MUSIC EDUCATION – NATIONAL ASSOCIATION FOR MUSIC EDUCATION (NAFME)

Core Music Standard: Responding

Analyze: Analyze how the structure and context of varied musical works inform the response.

Interpret: Support interpretations of musical works that reflect creators' and/or performers' expressive intent.

Evaluate: Support evaluations of musical works and performances based on analysis, interpretation, and established criteria.

Core Music Standard: Connecting

Connecting 11: Relate musical ideas and works to varied contexts and daily life to deepen understanding.



RESOURCES

HANDOUTS

- Handout 1 - Billie Eilish, “All Good Girls Go to Hell” Lyrics
- Handout 2 - Greenhouse Gas Emissions by Sector
- Handout 3 - A Letter from the Future