EARTH DAY

RESOURCES FOR MIDDLE GRADES

Earth Day 2025's theme is **Our Power, Our Planet**. The classroom resources below explore how we produce, use, waste, and need energy. The lessons and readings will inspire and guide your students to take informed action individually and push for greater systemic changes.

LESSON PLANS

- **Fracked or Fiction:** Students analyze information about fracking and their sources for bias and ultimately take a stance arguing for or against fracking.
- **In Search of Sustainable Life:** Students develop an index of the ten factors they identify as most important to a sustainable community and develop models for measuring those factors.
- **People and Climate Change: The Data is In:** Students interpret various forms of data (graphic, written, and visual) and identify relationships between population growth, greenhouse gas emissions, temperature rise, land ice melt, and sea level rise.
- **In the News: Research for Tomorrow:** Through planning, writing, and performing a news telecast, students use information from current events articles to create fact-based predictions about what their futures might look like.

FRACKED OR FICTION

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

Since the **Industrial Revolution**, we have lived in a highly energy dependent world, and that is especially true for the over 330 million people living in the United States. But where that energy comes from and what it is used for has changed and continues to change every day. In recent years, the use of **"fracking"** (a term short for slickwater horizontal high volume **hydraulic fracturing**) to extract natural gas and oil has been on the rise. In fact, the application of this type of drilling has doubled the estimated amount of recoverable natural gas in the U.S. over the past decade.[1] We can now access energy sources that were previously considered unreachable.

But this accessibility via fracking has been plagued with controversy and the science is not settled. Environmentalists are concerned with the water and air pollution caused by the drilling and social justice advocates point out that those near the wells are disproportionally impacted and put at risk. But on the other side, people tout that fracking helps the U.S. on the road to energy independence, has the potential for vast economic benefits, and replaces other, more damaging energy sources. Adding to the complexity is that our energy needs are always changing as population continues to increase – the U.S. is expected to be home to 400 million people by 2050. As the next generation of decision makers, today's young people must be able to navigate and consider the many sides of energy issues such as fracking.

MATERIALS

- Source Journal (provided)
- Gallery Walk Artifacts (provided)
- Graphic Organizer (provided)
- Computer/tablet with internet access

CONCEPT

The process of fracking to access natural gas and oil has major environmental, economic, and social implications.

OBJECTIVES

Students will be able to:

- Interpret fracking information from various sources of different types.
- Analyze and evaluate informational sources for potential bias.
- Take a position on fracking and support the position with evidence.
- Use valid reasoning to write an argument that is for or against fracking.

SUBJECTS

Science (Earth and environmental), social studies (geography), English language arts

SKILLS

Identifying trends and patterns, analyzing visual and numeric data, summarizing, identifying bias, forming an argument, defending a position using evidence

METHOD

Students analyze information about fracking and their sources for bias and ultimately take a stance arguing for or against fracking.

PROCEDURE

1. This lesson assumes that your students have a basic understanding of fracking. If they do not, consider using one of the following resources to introduce the topic: What is Fracking?, a video from National Geographic; Make a Fracking Model Activity, a lesson plan from InsideEnergy's AirWaterGas; or Collectively Photographing Fracking, a photo essay from the New York Times.

   Before class, tape the 12 Gallery Walk "Artifacts" around the room in numeric order. Try to evenly space them so that 2-3 students could be viewing one particular artifact at the same time. If you have internet access and a classroom computer or tablet, you can set up artifact #2 so that it is interactive and students explore data that is relevant to their own region. If you don't have a computer or internet access, then you can still proceed with the printed version of the station.

2. Review information sources with the class by having students respond to the following questions. (Students should already have knowledge of how to evaluate valid sources.)

   a. How do you usually find information when you want to make a decision about something?
   Answer: Many will likely say that they use online search engines, ask friends, or ask their parents.

   b. How do you know if something you read online is **biased** (unfairly prejudiced) or **unbiased** (based solely on fact and not feelings or opinions)?
   Answers may include: that the source uses opinion words, that it's written by someone who doesn't like the topic in question, or it tries to get you to take some sort of action or get your money. Make sure students understand that even if something uses real facts, it can still present the facts in a biased way. If it presents false or outdated information, that is not the same as a bias—that's just unreliable and shouldn't be used. Students can consider the source itself, such as whether the information is from a website ending with .gov, .edu, or .com.

   c. When conducting research, should we look for information from a source that is biased or unbiased?
   Answer: People should search for unbiased sources as much as possible so they can form their own opinions. However, sometimes you find something that is biased but supports your way of thinking, and you may choose to use it anyway.

3. Explain that students will be making an informed decision about whether fracking in the United States is an acceptable method for accessing energy. In order to do this, they will review 12 different artifacts including graphs, images, and excerpts from speeches and news articles. The artifacts all have reliable facts and **data**. However, some of the artifacts and their sources are strongly biased one way or the other, so it is up to students to decide whether they should use an artifact to support their argument for or against fracking.

4. Introduce students to the Source Journal, a tool to help them make informed decisions about fracking, and distribute copies to each student (they will each need one Source Journal page for each artifact). Model how to use the Source Journal by sharing the example artifact on page 6, the Understanding Fracturing Fluid infographic, with them and going through the questions. Use student input to complete the Source Journal and have them fill out their own Journal so they have a reference to bring with them to the Gallery Walk. Answers will vary for some questions, but here is a sample:

Artifact Title/Name: *Understanding Fracturing Fluid Infographic*
What year is it from? *2014*
What organization made it (who is the source)? *American Petroleum Institute*
Do you think the source is biased (for or against fracking) or neutral? Explain.
Biased for fracking because their goal is to increase the amount of fracking in the U.S.
Write one full sentence summarizing what this artifact is showing. Are there any patterns or interesting details?
This picture shows what kinds of things are in the water that is pushed underground to frack. Most of the fracking fluid is water and sand. Only a small percent is made up of other chemicals. All of the chemicals can be found in household items like soap and ice cream.
Would this be a good artifact to use as evidence when making your decision about fracking? Explain.
Yes, this is a good artifact because it shows interesting information about the water used in fracking. The source may have a positive opinion of fracking, but I think they are making an important point. It's interesting to know more about all of the chemicals that go underground.

OR

No, this is not a good artifact. It seems biased because the source that made it is an organization that wants to encourage more fracking so that it can sell more equipment and services. They use pictures to make the chemicals seem safe in order to say that fracking fluid is safe.

5. Explain the Gallery Walk to students. Each station contains one artifact. With 2-3 students starting at each station, they will travel through the stations in order. For each artifact, they will complete the Source Journal to identify the key components, summarize what information is communicated, and explain whether or not they think this would be useful information when forming their final opinion about fracking. Students should bring their pencils and Source Journals as they travel.

6. Give students 5-10 minutes at each station and then announce that they should move to the next station of the Gallery Walk. When time is up for all stations, students return to their seats with their completed Source Journals and pencils.

   Note: Timing for the Gallery Walk and the total number of stations can be adjusted based on your class time and student needs. Ideally, students should visit at least five stations so they can choose their top three artifacts in the next part of the lesson. However, they can visit all 12 stations if time permits.

7. Distribute a copy of the Fracked or Fiction? Graphic Organizer to each student and introduce it as a tool that will help them organize their thoughts on fracking and form an opinion. Ultimately, they will use their Graphic Organizer, along with their Source Journals, to write an op-ed that takes a pro-fracking or anti-fracking stance.

8. Give students time to follow the directions on the Graphic Organizer and complete it independently or in pairs. (You might also assign the Graphic Organizer as homework between class periods.) It will guide them to write their opinion statement about fracking and support it with three strong pieces of evidence. The evidence will be drawn from the top three artifacts they viewed during the Gallery Walk, so students will use their Source Journal as a resource. Students will also identify a possible argument their opponents could make, and form a counter-argument.

9. Using their completed Graphic Organizer as a guide, each student should write an op-ed explaining their pro-fracking or anti-fracking stance. They should start by stating if they are for or against fracking, include at least two of their reasons supporting their stance, point out a potential counter-argument and its weakness, and end with a strong conclusion statement.

ASSESSMENT

Monitor students during the Gallery Walk and review their Fracked or Fiction Graphic Organizers and op-ed.

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[1]Energy Information Agency. (2016). International Energy Outlook 2016.

FRACKED OR FICTION

SOURCE JOURNAL

Name: _____ Date: _____

Artifact Title/Name: _____

What year is it from? _____

What organization made it (who is the source)?

_____

Do you think the source is biased (for or against fracking) or neutral? Explain.

_____

_____

_____

Write one full sentence summarizing what this artifact is showing. Are there any patterns or interesting details?

_____

_____

_____

Would this be a good artifact to use as evidence when making your decision about fracking? Explain.

_____

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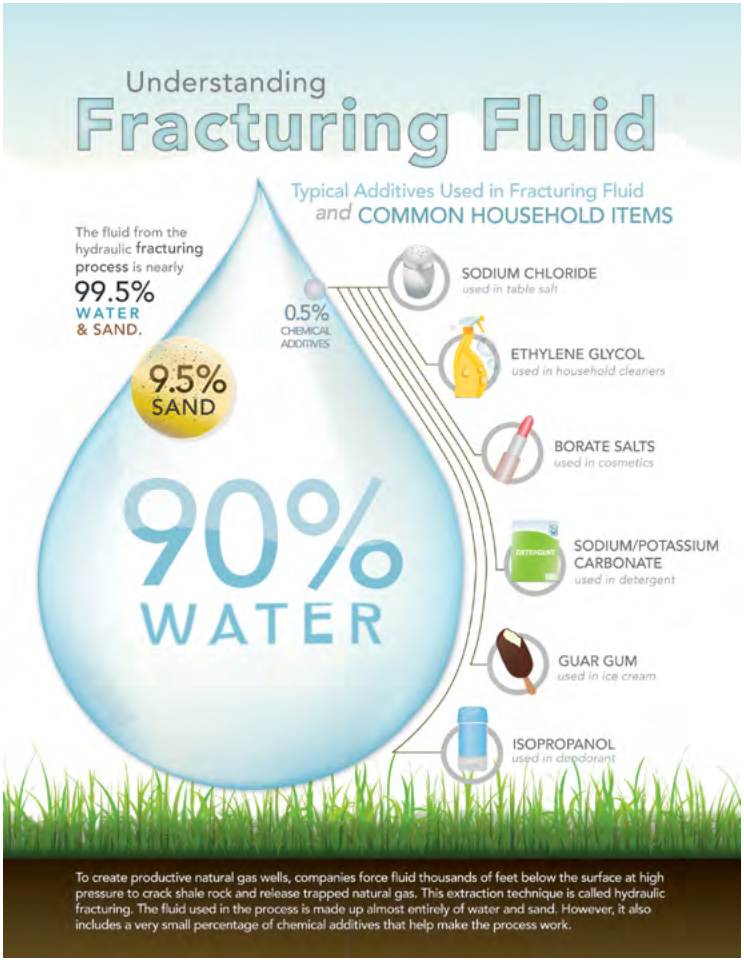
GALLERY WALK ARTIFACTS

TEACHER EXAMPLE ARTIFACT:

UNDERSTANDING FRACTURING FLUID INFOGRAPHIC



Source: American Petroleum Institute, November 2023. https://www.api.org/news-policy-and-issues/media/infographics/understanding-fracturing-fluid

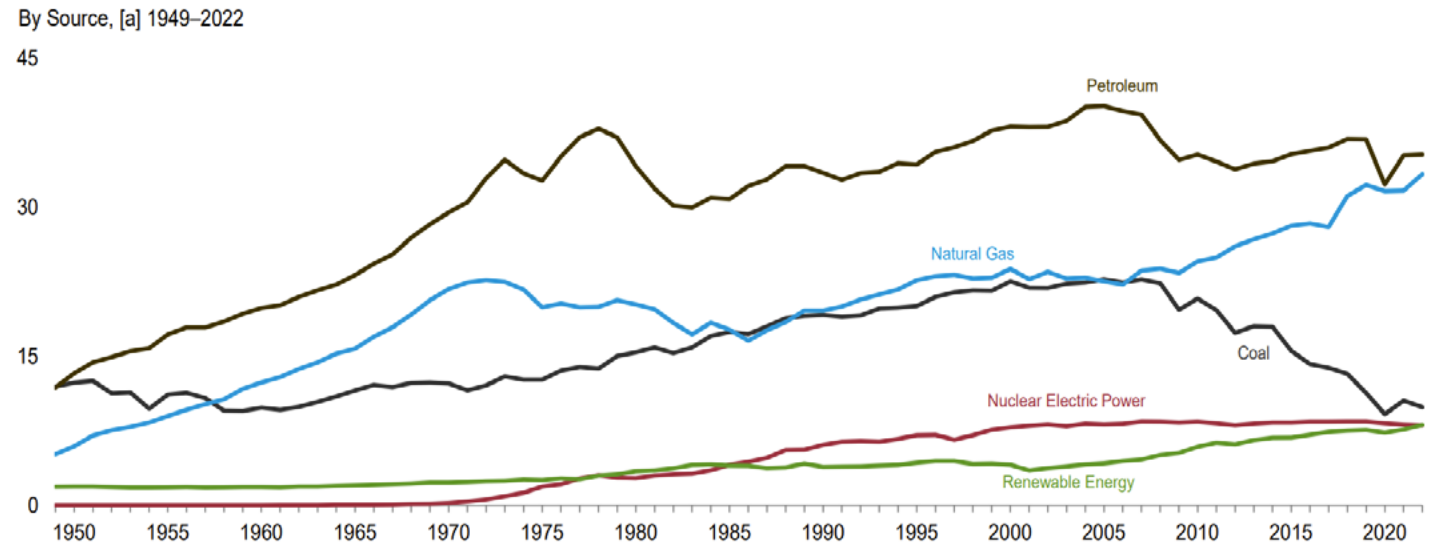
"Source" refers to who created the material; the organization, company, group, news outlet, etc. that published the information.

About the source: "API represents all segments of America's oil and natural gas industry. Its nearly 600 members produce, process and distribute most of the nation's energy. The industry supports millions of U.S. jobs and is backed by a growing grassroots movement of millions of Americans. API was formed in 1919 as a standards-setting organization. In our first 100 years, API has developed more than 700 standards to enhance operational and environmental safety, efficiency and sustainability."

"About the source" describes the source in their own words. The text is taken from the individual source's website.

ARTIFACT #1: US ENERGY CONSUMPTION BY SOURCE

Figure 1.3 Primary Energy Consumption
(Quadrillion Btu)

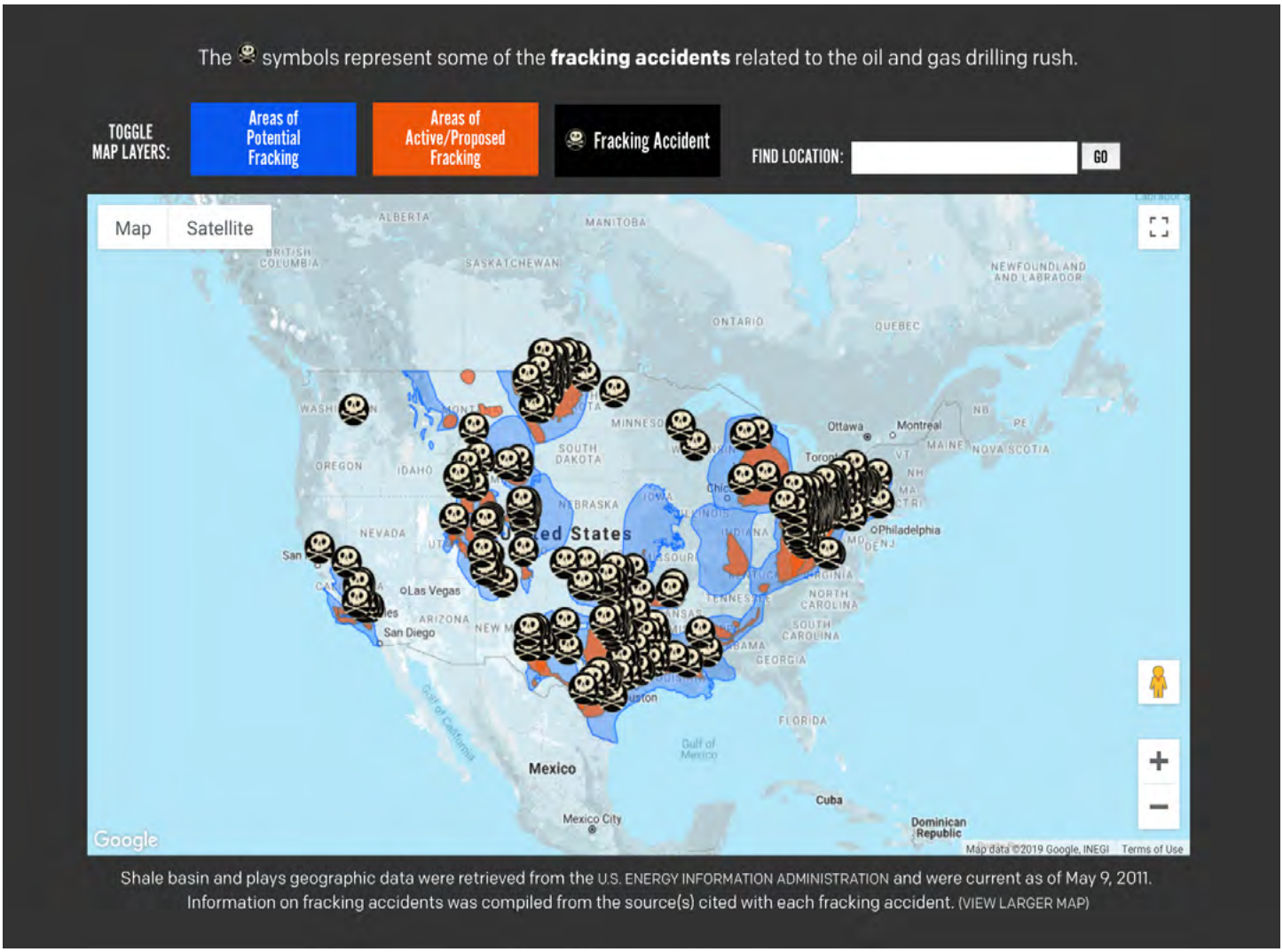


Source: Monthly Energy Review November 2023, United States Energy Information Administration. https://www.eia.gov/totalenergy/data/monthly/previous.php

About the source: "The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA is the nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the U.S. government."

ARTIFACT #2: FRACCIDENTS MAP

If you have internet access and at least one computer/tablet, set up a station with the following site for students to explore: http://earthjustice.org/features/campaigns/fracking-across-the-united-states.
If you are printing, use this image (or zoom in on the map for your own region and screenshot it):



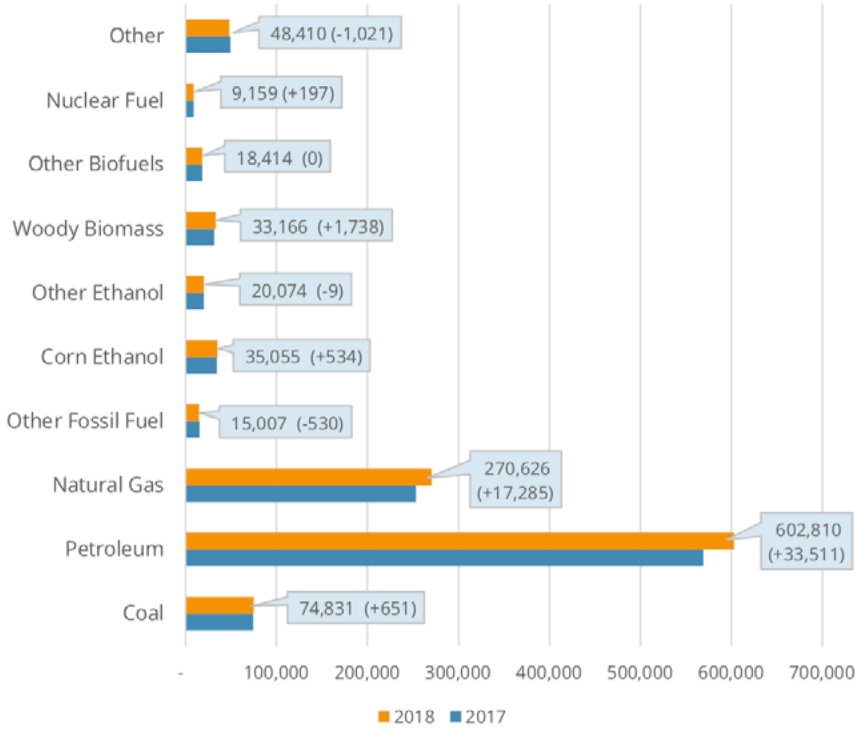
Caption: The United States is in the midst of an unprecedented oil and gas drilling rush—brought on by a controversial technology called hydraulic fracturing, or FRACKING. Along with this fracking-enabled rush have come troubling reports of poisoned drinking water, polluted air, mysterious animal deaths, industrial disasters and explosions. We call them FRACCIDENTS.

Source: Earthjustice.org, 2015. http://earthjustice.org/features/campaigns/fracking-across-the-united-states

About the source: "Today's environmental challenges are greater than ever. But we live in a country of strong environmental laws—and Earthjustice holds those who break our nation's laws accountable for their actions...As the nation's original and largest nonprofit environmental law organization, we leverage our expertise and commitment to fight for justice and advance the promise of a healthy world for all. We represent every one of our clients free of charge."

ARTIFACT #3: OIL AND GAS JOBS

Figure 4.
Fuels Sector – Employment by Detailed Technology Application, 2017-2018



Manufacturing employers in the Fuels sector expect an increase in employment of over 4 percent in 2019, while professional business services project to increase employment by over 5 percent during the same time period, as shown in Figure 5.

Source: 2019 U.S. Energy and Employment Report by the National Association of State Energy Officials and the Energy Futures Initiative, 2019. https://www.usenergyjobs.org/

About the source: "The EFI [Energy Futures Initiative] team of experts provide policymakers, industry leaders, NGOs and other leaders with analytically-based, unbiased policy options to advance a cleaner, safer, more affordable and more secure energy future." "NASEO facilitates peer learning among state energy officials, serves as a resource for and about state energy offices, and advocates the interests of the state energy offices to Congress and federal agencies."

ARTIFACT #4: STATE OF THE UNION ADDRESS 2012

"We have a supply of natural gas that can last America nearly 100 years. And my administration will take every possible action to safely develop this energy. Experts believe this will support more than 600,000 jobs by the end of the decade. And I'm requiring all companies that drill for gas on public lands to disclose the chemicals they use. Because America will develop this resource without putting the health and safety of our citizens at risk.

The development of natural gas will create jobs and power trucks and factories that are cleaner and cheaper, proving that we don't have to choose between our environment and our economy. And by the way, it was public research dollars, over the course of 30 years, that helped develop the technologies to extract all this natural gas out of shale rock – reminding us that government support is critical in helping businesses get new energy ideas off the ground."

Source: President Barack Obama, State of the Union Address, 2012 - https://obamawhitehouse.archives.gov/the-press-office/2012/01/24/remarks-president-state-union-address

ARTIFACT #5: FRACKING SPILLS DATA FROM THE ENVIRONMENTAL PROTECTION AGENCY (EPA)

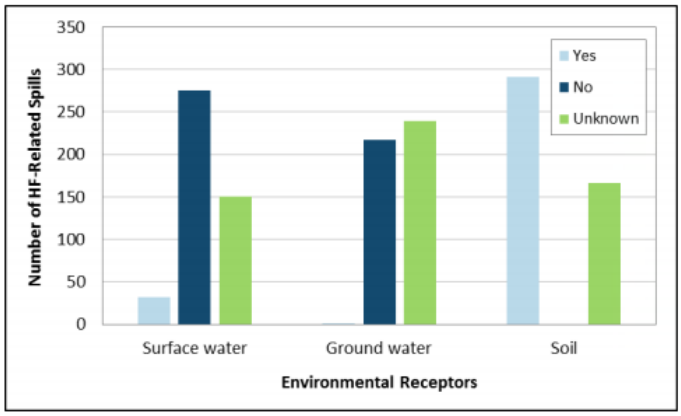


Figure 8. Number of hydraulic fracturing (HF)-related spills in which spilled fluids reached (yes) or did not reach (no) surface water, ground water, or soil. "Unknown" refers to hydraulic fracturing related spills for which environmental receptors were specified as unknown or were not identified.

Table 9. Number of hydraulic fracturing-related spills, total reported volume spilled, and reported volume per spill by environmental receptor. There were 300 hyraulic fracturing-related spills that reached environmental receptors. Twenty-four of these 300 spills reached both soil and surface water receptors and were counted as having reached two separate rececptors. Therefore, the number of receptors reached sums to 324. "NA" indicates "not applicable."

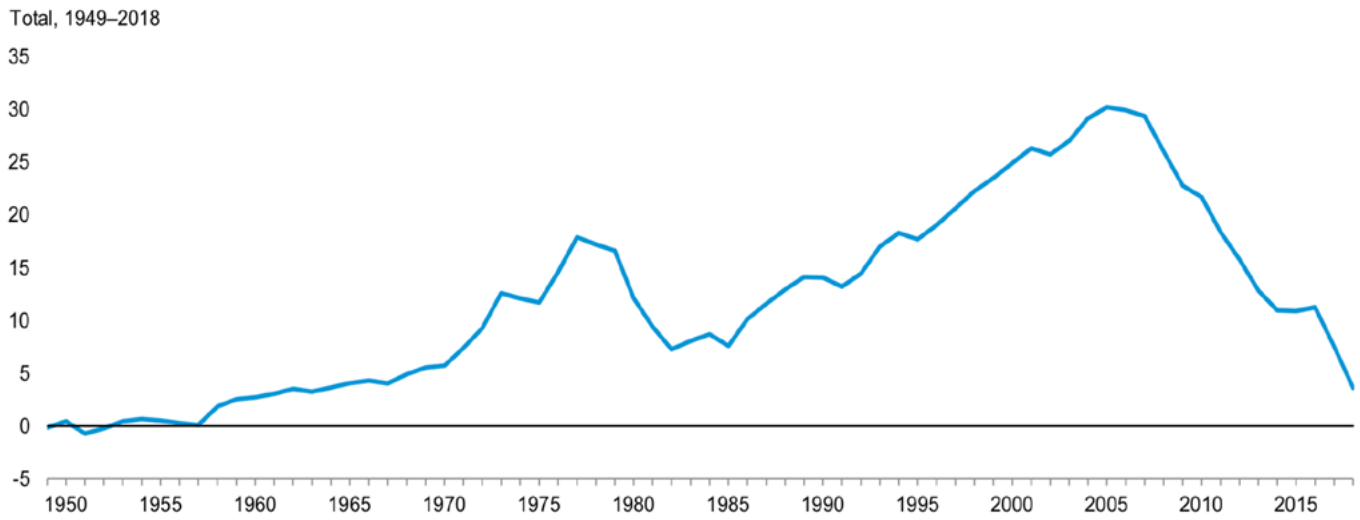
Environmental Receptor	Number of Spills	Total Reported Volume Spilled (Gallons)
Soil	291	540,000
Surface Water	32	200,000
Ground Water	1	130

Source: "Characterization of Hydraulic Fracturing-Related Spills" EPA Report May 2015 - https://epa.gov/sites/production/files/2015-05/documents/hf_spills_report_final_5-12-15_508_km_sb.pdf

About the source: The United States Environmental Protection Agency (EPA) is a government agency formed in 1970 to enforce United States regulations and laws related to the environment. The mission of EPA is to protect human health and the environment.

ARTIFACT #6: HISTORICAL US ENERGY IMPORTS

Figure 1.4b Primary Energy Net Imports
(Quadrillion Btu)



Source: Monthly Energy Review September 2019, United States Energy Information Administration
https://www.eia.gov/totalenergy/data/monthly/archive/00351909.pdf

About the source: "The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA is the nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the U.S. government."

ARTIFACT #7: *SANTA FE NEW MEXICAN* NEWSPAPER ARTICLE ON FRACKING BAN

A New Mexico county's fracking ban is all about the water

"We've lived off the land for five generations," said Roger Alcon, 63, looking out on a Northern New Mexico landscape of high mesas, ponderosa pines and black Angus cattle. "We have what we need. We've been very happy, living in peace."

Wells are the Alcons' only source of water. The same is true for everyone else in Mora County, which is why last month this poor, conservative ranching region of energy-rich New Mexico became the first county in the nation to pass an ordinance banning hydraulic fracturing, the controversial oil and gas extraction technique known as "fracking" that has compromised water quantity and quality in communities around the country.

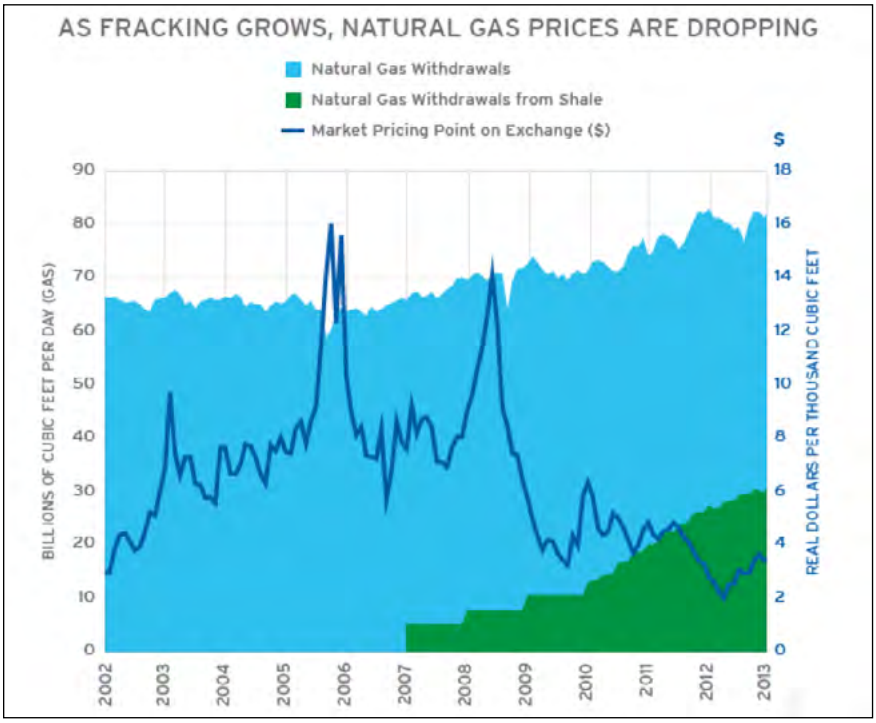
"I don't want to destroy our water," Alcon said. "You can't drink oil."

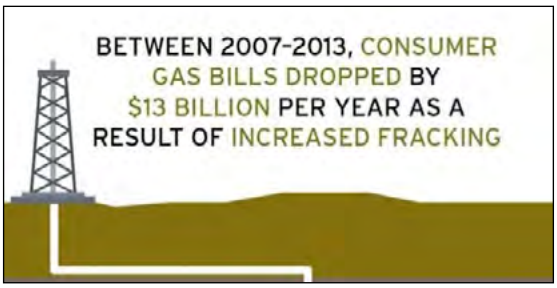
Sandra Alcon said her neighbors don't care about mineral rights or oil money. They are angry about the way energy companies' "land men" treated them. Residents here are seen as easy marks for hustlers offering little compensation for oil and water rights, she said.

Source: "A New Mexico county's fracking ban is all about the water" by Julie Cart, Santa Fe New Mexican, 2013. https://www.santafenewmexican.com/news/local_news/a-new-mexico-county-s-fracking-ban-is-all-about/article_33ed23fb-2b73-565d-82d9-003315686485.html

About the source: "Daily coverage of news, arts, sports, education, politics, environment and more in Northern New Mexico."

ARTIFACT #8: FRACKING GROWTH AND FALLING NATURAL GAS PRICES



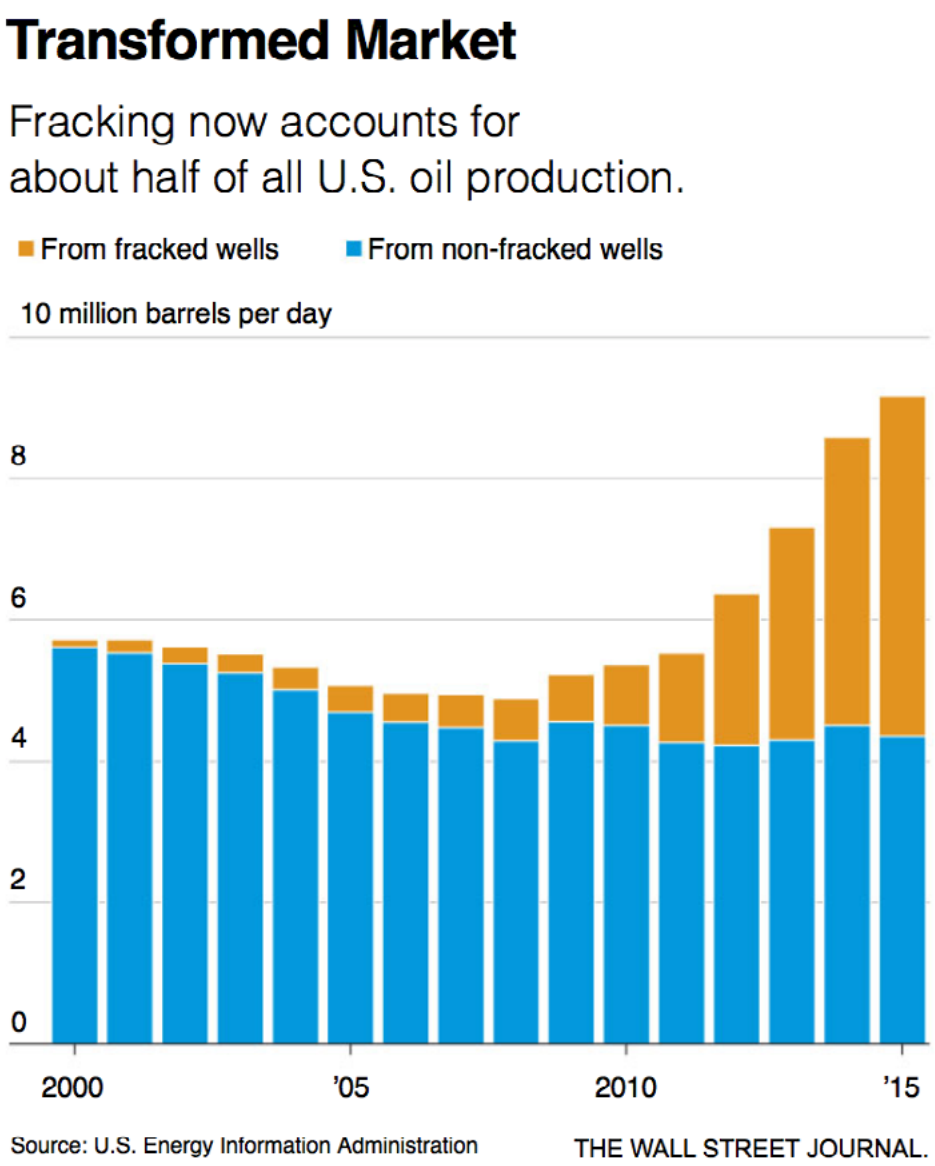


Note: Gross withdrawals include not only marketed production, but also natural gas used to repressure wells, vented and flared gas, and non-hydrocarbon gases removed. Source: U.S. Energy Information Administration.

Source: Brookings Institution, "The Economic Benefits of Fracking." https://www.brookings.edu/blog/brookings-now/2015/03/23/the-economic-benefits-of-fracking/

About the source: "The Brookings Institution is a nonprofit public policy organization based in Washington, DC. Our mission is to conduct in-depth research that leads to new ideas for solving problems facing society at the local, national and global level."

ARTIFACT #9: NATURAL GAS PRODUCTION GRAPH

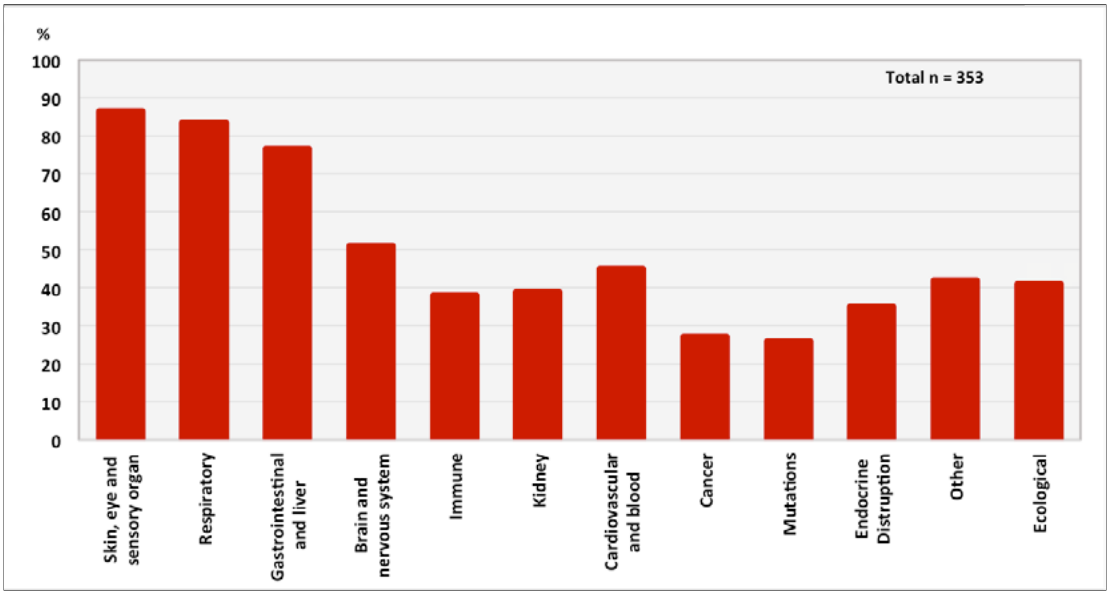


Source: The Wall Street Journal. https://www.wsj.com/articles/fracking-2-0-shale-drillers-pioneer-new-ways-to-profit-in-era-of-cheap-oil-1490894501

About the source: The Wall Street Journal is a business-focused, English language international daily newspaper based in New York City.

ARTIFACT #10: HEALTH EFFECTS OF FRACKING CHEMICALS

Health Effects Related to Oil and Gas Chemicals (Colborn et. al. 2010)

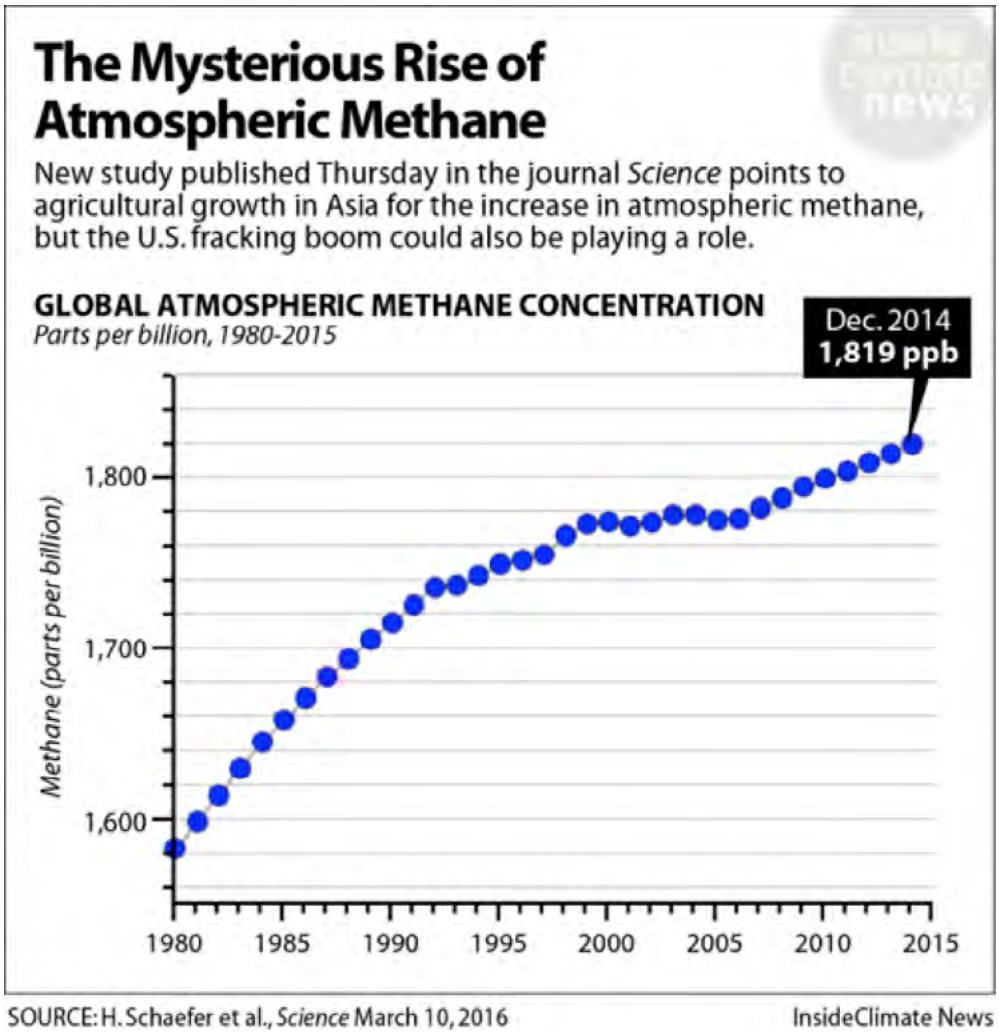


Human exposure to fracking chemicals can occur by ingesting chemicals that have spilled and entered drinking water sources, through direct skin contact with the chemicals or wastes (e.g., by workers, spill responders or health care professionals), or by breathing in vapors from flowback wastes stored in pits or tanks. The paper "Natural Gas Operations from a Public Health Perspective" summarized health effect information for 353 chemicals used to drill and fracture natural gas wells in the United States. The chart above illustrates what percentage of the 353 chemicals studied would possibly cause 12 health effects. (For example: 88% of the natural gas-related chemicals studied impacted a person's skin, eye, and sensory organ health.)

Source: Earthworks "Hydraulic Fracturing 101." https://www.earthworks.org/issues/hydraulic_fracturing_101/

About the source: "Earthworks is a nonprofit organization dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions. Earthworks stands for clean air, water and land, healthy communities, and corporate accountability. We work for solutions that protect both the Earth's resources and our communities."

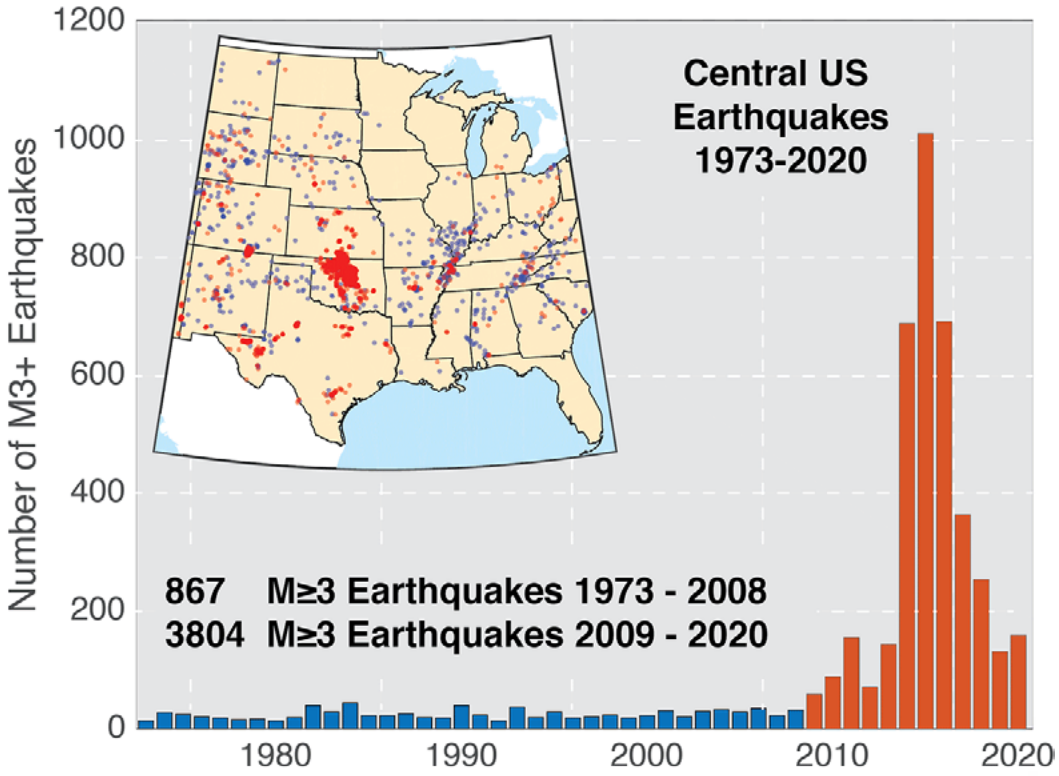
ARTIFACT #11: THE MYSTERIOUS RISE OF ATMOSPHERIC METHANE GRAPH



Source: InsideClimate News. https://insideclimatenews.org/news/10032016/mysterious-global-methane-rise-asian-agriculture-or-us-fracking/

About the source: "InsideClimate News is an independent, non-profit, non-partisan news organization that covers clean energy, carbon energy, nuclear energy and environmental science - plus the territory in between where law, policy and public opinion are shaped. We are staffed by professional journalists, many of whom bring decades of experience from leading media organizations in the nation, including the Wall Street Journal, New York Times, ProPublica, Los Angeles Times, Bloomberg News and Frontline. We have earned national recognition for our work and many of the most prestigious awards in journalism, including the Pulitzer Prize for National Reporting."

ARTIFACT #12: MAP OF EARTHQUAKE ACTIVITY IN THE CENTRAL UNITED STATES



Annual number of earthquakes with a magnitude of 3.0 or larger in the central and eastern United States, 1973-2020. The long-term rate of approximately 25 earthquakes per year increased sharply starting around 2009. (Public domain.)

Also from the source…

"Fracking is not directly causing most of the induced earthquakes. Disposal of waste fluids that are a byproduct of oil production is the primary cause of the recent increase in earthquakes in the central United States.

Wastewater is produced at all oil wells, not just hydraulic fracturing sites.

In many locations, wastewater has little or nothing to do with hydraulic fracturing. In Oklahoma, less than 10% of the water injected into wastewater disposal wells is used hydraulic fracturing fluid. Most of the wastewater in Oklahoma is saltwater that comes up along with oil during the extraction process.

In contrast, the fluid disposed of near earthquake sequences that occurred in Youngstown, Ohio, and Guy, Arkansas, consisted largely of spent hydraulic fracturing fluid."

Source: United States Geological Survey (USGS). https://www.usgs.gov/programs/earthquake-hazards/science/induced-earthquakes-overview

About the source: "The USGS is the sole science agency for the Department of the Interior…On March 3, 1879, we were established by the passing of the Organic Act through Congress. Our main responsibilities were to map public lands, examine geological structure, and evaluate mineral resources. Over the next century, our mission expanded to include the research of groundwater, ecosystems, environmental health, natural hazards, and climate and land use change."

FRACKED OR FICTION

GRAPHIC ORGANIZER

Name: _____ Date: _____

State your position : I believe fracking is _____

...because (here are my 3 reasons)

Reason #1 _____

_____

_____

Supporting Fact(s) _____

_____

_____

Source: _____

Reason #2 _____

_____

_____

Supporting Fact(s) _____

_____

_____

Source: _____

Reason #3 _____

_____

_____

Supporting Fact(s) _____

_____

_____

Source: _____

Counter-Argument

Your could argue that... _____

_____

_____

_____

_____

_____

_____

But here's the weakness in that argument:

_____

_____

_____

_____

_____

_____

_____

Strong Conclusion: I believe fracking is _____ because (state your three reasons) _____

_____

IN SEARCH OF SUSTAINABLE LIFE

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

We all want to live in a community that contains the resources needed to survive, is safe, clean, and provides adequate public services such as schools and a fire department. But it would be shortsighted to consider only the needs of community members here today. The human population is constantly expanding – roughly 84 million people join our ranks every year. How can we ensure future generations continue to benefit from the resources we enjoy today? How do we know if a community is **sustainable**?

More often than not, the progress of cities, states, and countries is measured with an economic index. The **gross domestic product (GDP)** measures the value of all goods and services produced in a certain place. And while GDP is a good indicator of economic activity, it does not account for many social and environmental factors that influence a community's sustainability. The World Resources Institute points out that a "country could sell off its timber and minerals, erode its soils, pollute its aquifers, deplete its fisheries and the national accounts would treat all the proceeds as current income." But suppose this happened. How would future generations survive and thrive without timber, nutrient soil, and clean water?

Economic activity does not tell the whole story. There are additional factors within a community that point to sustainability but are not measured in economic terms.

MATERIALS

- Community Photo Bank (provided)
- Foldable Template (provided)

CONCEPT

A sustainable community is characterized by environmental, social, and economic factors that allow it to prosper and thrive long-term.

OBJECTIVES

Students will be able to:

- Define sustainable community.
- Name three different types of sustainability and categorize factors representing each.
- Assess and prioritize factors of sustainability to create a Sustainability Index.
- Apply the Sustainability Index to their own community, identifying where improvements could be made and potential challenges.

SUBJECTS

Social studies (economics), science (Earth and environmental)

SKILLS

Analyzing and interpreting visual sources, values identification, decision making, prioritizing, critical thinking

METHOD

Students develop an index of the ten factors they identify as most important to a sustainable community and develop models for measuring those factors.

PART 1: A SUSTAINABILITY INDEX PROCEDURE

1. Have 'Sustainable Community' written on the board and ask students to quietly consider what the term means. You may need to have them take each word independently first. If your students are not familiar with the concept of sustainability, have them first define the root 'sustain.' Additionally, you could use it in a few sample sentences, such as "The amount of money I was paying every week for groceries was not sustainable" or "We are using up our finite supply of fossil fuels so quickly that it's not sustainable."

2. Using student input, create a working definition of "sustainable" on the board for easy reference throughout the lesson.

3. One by one, display the photos found in the Community Photo Bank and for each, ask students to answer the question: Is this community sustainable? Why or why not?

   Note: Students' answers at this point will be guesses; they will be deciding what makes a sustainable community throughout the remainder of the lesson.

4. Explain the three types of sustainability to students and provide one example of each.

Three Main Types of Sustainability

Type of sustainability	Examples of factors
Human/Social – pertaining to the health and happiness of individuals and the society	Access to education; health care, and nutritious food; citizen involvement; community safety/low crime
Environmental – pertaining to the natural environment and resources on which all living things depend	Proper waste management; accessible green spaces (parks); public transportation; clean air/water/land
Economic – pertaining to monetary capital (money)	Healthy businesses; revenue for the city; job opportunities

5. In small groups, challenge students to brainstorm what factors found in a community would make it sustainable. Encourage students to think in a broad sense, considering more than what would make their own life sustainable, and to be specific. Refer students to the example you shared for each type of sustainability if they need guidance getting started. At this point, focus on quantity with the expectation that each group's list may include 15-20 factors.

6. As the students work in their groups, divide the board into three sections with the following labels: Human/Social, Environmental, and Economic.

7. Come together as a class and ask a representative from each group to share their factors. With each factor shared, discuss which type of sustainability it represents and write it on the board in the appropriate column. Some factors may contribute to more than one type of sustainability and be listed under more than one heading. For instance, bike lanes could be a social factor because they improve quality of life but also an environmental factor because they reduce emissions from automobiles.

8. Now it's time to produce a usable index that measures the sustainability of a community. Based on all the factors listed on the board, conduct a vote to determine which 10 factors the class considers most vital in determining whether or not a community is sustainable. These factors will make up the class Sustainability Index. You may want to give students time to consider the large list independently and perhaps do their own ranking of top 10 factors before the class vote.

Sample Sustainability Index

Human/Social	Environmental	Economic
Waste management Access to fresh and nutritious food Quality health care Quality education	Green space Water conservation Low pollution Mass transit options	Citizen involvement Small business support

PART 2: SUSTAINABILITY IN MY COMMUNITY

PROCEDURE

1. The class Sustainability Index is complete and now students will put it to use in their own community. Divide students into nine groups and distribute a copy of the Foldable Template to each group. (The printed side with text will be the "outside" of the foldable so the text serves as the cover.)

2. Assign, or have each group select, one factor from the class Index. There should be one factor left unassigned.

3. Follow the diagram below to model for students how to create their foldable – both how to fold and cut it (fold on dotted line; cut on zigzag line) and how to fill it in. Use the remaining factor that was not assigned to a student group.

FOLDED:

Our Community *What do we know about this factor in our community?*	Improvements *What can we do to improve this factor in our community?*	Challenges *What challenges might we face when trying to make these improvements?*
FACTOR		

UNFOLDED:

Observation Observation	Improvement Improvement	Challenge Challenge
Observation	Improvement	Challenge
FACTOR		

EXAMPLE:

• Lots of trees by school • No trees near my house • Not many parks	• Plant a tree in my neighborhood • Turn old parking lot into a park	• Getting money for a tree • Convincing the owner of the lot to change it to a park
• Most people have big lawns • Lots of shrubs in front of businesses		• Caring for the park – mowing the grass • Making sure people know about the park
GREEN SPACE		

4. When finished, have groups pair up and discuss their foldables. Each group should first explain their foldable and then field questions from the other group.

ASSESSMENT

Evaluate students' participation in the creation of the Index and class discussion in Part 1. Review the groups' foldables and monitor small group discussion in Part 2.

FOLLOW-UP ACTIVITIES

1. In addition to their observations from the foldable, students conduct focused research on their individual factor in your community and report their findings back to the class.

   For their factor, have students determine a source where they could find relevant information and then track it down. For example, they could contact the city's department of public works and ask if they have statistics on recycling participation. Once students know statistics of their factor, have them consider questions such as:

   - How does my community rank in terms of this factor? If it's poorly, how could this be improved?
   - How does my community compare to neighboring communities in terms of this factor?
   - Has this factor improved or gotten worse in recent years?

2. Students choose one of their possible improvements to the community, outline a detailed proposal for this plan, and send it to select local government officials. They might also want to send the full Sustainability Index so that city officials can determine what students care about in their community.

3. Students apply their Sustainable Community Index more narrowly to your school itself. For example, consider whether the building and grounds have adequate green space, a strong recycling program, and is there access to nutritious food in the cafeteria. Students design improvements and action plans to submit to school administrators based on their findings.

4. Students compare the level of sustainability in your community to one that has been studied in class in a different country. How are they similar and dissimilar? Have students write a one-page paper comparing the two communities.

5. Share the image below of the UN Sustainable Development Goals. Explain to students that these 17 ambitious goals were created as a "universal call to action to end poverty, protect the planet, and to ensure that people around the globe enjoy peace and prosperity." Students pick one goal, decide what type of sustainability it represents, and investigate how it relates to a sustainable community at a more local level. For example, SDG#4, Quality Education – What would it look like if this goal was met in the local community?

IN SEARCH OF SUSTAINABLE LIFE
COMMUNITY PHOTO BANK

"1st Street NE cycletrack, Washington DC" by BeyondDC, CC BY-NC-ND 2.0

"Whitefield Park" by Mikey, CC BY 2.0

IN SEARCH OF SUSTAINABLE LIFE
COMMUNITY PHOTO BANK - PAGE 2

Photo from "Healthy Harbor Announces Campaign for New Canton Water Wheel" from the Waterfront Partnership of Baltimore

Photo from "Mundelein Farmers Market Exceeding Expectations of Vendors and Residents" from the Village of Mundelein

IN SEARCH OF SUSTAINABLE LIFE
COMMUNITY PHOTO BANK - PAGE 3

"Street Crossing Guard on Egan Drive, Juneau, Alaska" by Gillfoto, CC BY-SA 4.0

IN SEARCH OF SUSTAINABLE LIFE
FOLDABLE TEMPLATE

Our Community *What do we know about this factor in our community?*	Improvements *What can we do to improve this factor in our community?*	Challenges *What challenges might we face when trying to make these improvements?*

PEOPLE AND CLIMATE CHANGE: THE DATA IS IN

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

There is scientific consensus that our climate is changing and it's happening at an alarming rate. Concentrations of atmospheric **carbon dioxide** are at the highest levels seen in centuries and are steadily climbing, average annual temperatures continue to soar, and all of Earth's environmental systems are suffering as a result. The root cause of all this sudden change is people. Around the dawn of the Industrial Age, human population began growing exponentially. The burning of **fossil fuels** powered a new modern life and led to a sharp increase in the amount of **greenhouse gases** in the atmosphere. This growing abundance of greenhouse gases (largely carbon dioxide) has had a ripple effect around the world, causing temperatures to increase, ice to melt, and, ultimately, seas to rise.

Scientists continuously collect **data** to monitor the many impacts of **climate change** and to make predictions about the future. By analyzing climate-related graphs, visual images, and news articles, people can begin to understand the many cause and effect relationships that are shaping our changing world.

MATERIALS

- Butcher paper
- Glue sticks or tape
- Markers
- Data Bank Items (provided)
- Student Worksheet
- 4 computers/tablets with internet access

PROCEDURE

Preparation, Before Class:

1. Prepare the Data Bank Readings: Print two copies of each of the following articles: "The Battle for Coral Reefs" and "Two-thirds of glaciers on track to disappear by 2100, study finds." The TIME for Kids website allows for scaling the article to different reading levels.

CONCEPT

The Earth's climate is changing rapidly due to the rise in greenhouse gas emissions from human activity. Climate change impacts all of Earth's systems and these changes are evident in graphic, written, and visual data.

OBJECTIVES

Students will be able to:

- Interpret information of various formats (graphic, written, and visual) and draw meaningful conclusions.
- Consider the benefits and drawbacks of certain types of data representation.
- Hypothesize cause and effect relationships between human population growth, increasing greenhouse gas emissions, temperature rise, land ice melt, and sea level rise.

SUBJECTS

Science (Earth and environmental Science), social studies (geography), math, English language arts

SKILLS

Analyzing visual and numeric data, reading comprehension, summarizing, drawing connections among data, identifying trends and patterns

METHOD

Students interpret various forms of data (graphic, written, and visual) and identify relationships between population growth, greenhouse gas emissions, temperature rise, land ice melt, and sea level rise.

2. Prepare the other Data Bank Items: Make two color copies of each of the other Data Bank Items.

3. Copy the Student Worksheet: for each pair of students, copy all pages of the Worksheet and cut along the dotted lines to create a set of 14 half-sheets. Students will use these to analyze the Data Bank Items.

4. Mix up the Worksheet half-sheets in each set so they are in random order.

5. Place the two copies of each Data Bank Item at the front of the classroom at random. (For instance, don't have all the information related to temperature rise in the same area.)

Facilitating the Activity:

1. Divide the class into pairs.

2. Ask students to think-write-pair-share three things they already know about climate change with their partner. (This lesson will work best if students already have a working knowledge of the basic causes and impacts of climate change.)

3. Point out the Data Bank at the front of the classroom and explain that students will be analyzing pieces of data related to climate change, but that the data isn't just numbers – it's graphs, images, articles, and more.

Data Bank Items:

Theme	Data	Form
Population Growth and Greenhouse Gasses	Carbon emissions and population growth (1751 – 2010)	Online data visualization
	Greenhouse gas emissions by gas	Pie chart
	World Population Growth 1 CE - 2050 CE	Line graph
	CO2 levels over the past 400,000 years	Line graph
Temperature Rise	Greenhouse effect	Visual diagram
	Article: "The Battle for Coral Reefs"	Nonfiction article
	Inuit quotes on change in Nunavut, Canada	Text/Quotes
	Global temperature maps (1884 – 2020)	Time series maps
Land Ice Melt*	Video: "Rain falls at Greenland ice summit for first time"	Video (1:46)
	Article: "Two-thirds of glaciers on track to disappear by 2100, study finds"	Nonfiction article
	Muir Glacier before (1941) and after (2004)	Photo
Sea Level Rise	Possible future sea levels for different greenhouse gas pathways	Line graph
	Relative sea level trends, U.S. and Canada	Map
	Flooding in Bangladesh	Photo and map

* The ice melt examined in this activity refers to land ice melt like glaciers and ice sheets that, when melted, contribute to sea level rise.

4. To begin, one person from each pair comes to the front of the room and picks a piece of data from the Bank. Don't give the students guidance on what to pick first; the data should be chosen at random.

5. Each pair will find their corresponding Worksheet half-sheet by matching their image thumbnails with the Data Bank Item they've selected. Then they'll answer the questions on the Worksheet half-sheet based on the data. When finished, students should return the Data Bank Item to the Bank, and then select another piece to analyze. Completed Worksheet half-sheets should be kept at their desk.

   Note: For more monitoring, students could be required to bring each completed Worksheet half-sheet to the teacher for a quick check on understanding and completion before getting another piece.

6. Tell students that as they collect and analyze data, they should think about two things:

   a. Is this information *communicating the same point* as any other data I've already seen?
   b. Is this information *related* to any of the other information – either as a direct cause or direct effect?

   Note: All the information in the Data Bank can be grouped into four general themes, as indicated in the Data Bank Chart: 1. population growth and the rise of greenhouse gas emissions, 2. temperature rise, 3. land ice melt, and 4. sea level rise. There are several pieces of data for each theme – all of which represent the same general point, but through different methods (graph, data visualization, written article, image, etc.). Students might put the J-Curve graph of human population growth in its own group, and that's okay.

7. Tell students that Worksheet half-sheets representing the same idea should be grouped. Student pairs should label each half-sheet, on the bottom right, with the theme they think each group of data is communicating. Next, they should attach each piece of data (still in groups) to the butcher paper and illustrate relationships between groups of data with arrows.
   Answer: In a basic sense, growing population → more greenhouse gases in the atmosphere → temperature rise → land ice melt → sea level rise. However, depending on their climate background knowledge, students may be able to make more connections between these topics (e.g. ice melt leads to more greenhouse gas due to the release of methane).

ALTERNATE PROCEDURES

1. For younger students, or to save time, divide the class into groups of four or five. Give each group the Data Bank Items and Worksheet half-sheets from only one theme. After groups have had time to analyze all of their information, each group shares with the class one sentence that summarizes what their data conveyed, what format (graphic, visual, etc.) they thought best represented that information and why. Next, ask students to determine how their group's information relates to that of the other groups. Take time for each group to share and create a class web illustrating the connections that are discussed.

2. Eliminate some of the data. Including only one or two Data Bank Items from each category would cut down on time and make it easier for younger students to draw connections.

Answers to Student Worksheet
See Answer Key

DISCUSSION QUESTIONS

1. What piece of data did you find the most difficult to understand? Why do you think this is?

2. What form of information (visual, graphic, written) do you find the most effective? What are the benefits and drawbacks to each type of representation?

   Answers will vary. Students may feel that visual images are more powerful and interesting but lack in details, that data visualizations are easier to understand than line graphs, that line graphs best represent change over time, that articles have more information but take more time to process, etc. Some students may prefer to just look at numbers.

3. Temperature change, land ice melt, and the resulting rise in our seas all stem from the increase of greenhouse gases in our Earth's atmosphere. How has population growth contributed to the rise in greenhouse gases?

   Fossil fuels power our lives. With more people, there are more cars on the road, more factories producing consumer goods, more food being processed, and more electricity being used. All of these human activities emit greenhouse gases and throw off Earth's natural cycles.

4. Why do you think both population growth and CO_2 emissions drastically increased in the 19th century?

   Both population and carbon emissions grew after the dawn of the Industrial Revolution when advances in medicine, technology, and sanitation led to longer life expectancy as well as higher demand for energy. Also, advances during the Industrial era allowed us to harness energy from fossil fuels in massive quantities like never before. An ever-growing and ever-consuming population meant continued increases in carbon use.

5. Do you think the relationships you see between the themes of data are correlative or causative? Defend your answer.

   The science is clear that more greenhouse gases in our atmosphere are causing rising temperatures. These rising temperatures cause ice to melt and when land ice melts and flows into the oceans, sea level rises.

6. Pick one of the cause and effect relationships between two themes. Can you think of other factors that may be at play?

   Answers will vary. Depending on their knowledge of climate change, students may mention things like permafrost melt releasing greenhouse gases or that as temperatures rise, sea water expands which contributes to sea level rise.

7. Are there any impacts of climate change that were not addressed in the Data Bank?

   Yes, there are many: coral bleaching, changes in weather patterns (more severe storms, extended droughts and shorter growing seasons), risks to wildlife health, changes in wildlife migration patterns, etc. All of these changes have far-reaching impacts on the well-being of both wildlife and humans.

8. What could be done to halt or slow the advance of climate change? Hint: think about the driving causes.

   Stabilizing population growth would be a good place to start. But it's not only about our numbers – it's also about how we use resources. Decreasing our dependency on fossil fuels and using more renewable energy sources like solar and wind can make a big impact. Individuals can play a part by driving less, buying fewer material goods, eating local, and spreading the word to others. Governments can help by creating laws or policies that encourage sustainable behaviors like implementing carbon taxes, limits on greenhouse gas emissions, subsidies for companies and products that reduce emissions, etc. In addition to emitting less, we can protect and plant trees which absorb CO2 from the atmosphere. Scientists and engineers are constantly brainstorming new technologies to help reverse Earth's rise in temperature.

ASSESSMENT

Students complete the following statements, as they relate to interactions between the four themes of data:

I learned that: _____

I was surprised about: _____

I felt: _____

FOLLOW-UP ACTIVITIES

1. Have students consider their local community and write a reflection on how climate change is impacting their own region.

2. Have students add additional data to their butcher paper. One option could be to add a category for the future implications of climate change. Or, to add data on climate issues that were not addressed in this lesson to create a 'web' structure. New topics could include changes in weather patterns, wildlife or human migrations, sea ice melt, impacts on the economy, etc.

PEOPLE AND CLIMATE CHANGE: THE DATA IS IN

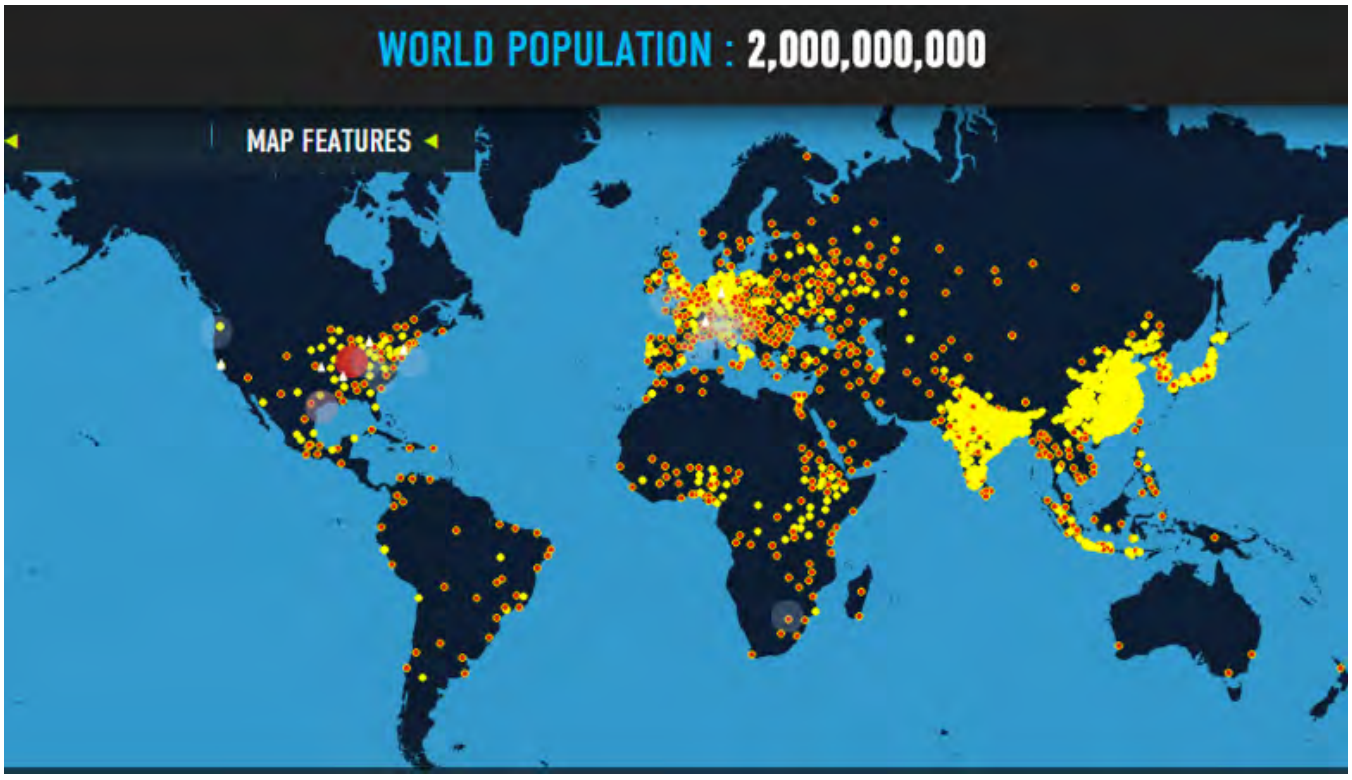
DATA BANK ITEMS

Print two color copies of the two articles linked here and two color copies of each of the following Data Bank Items.

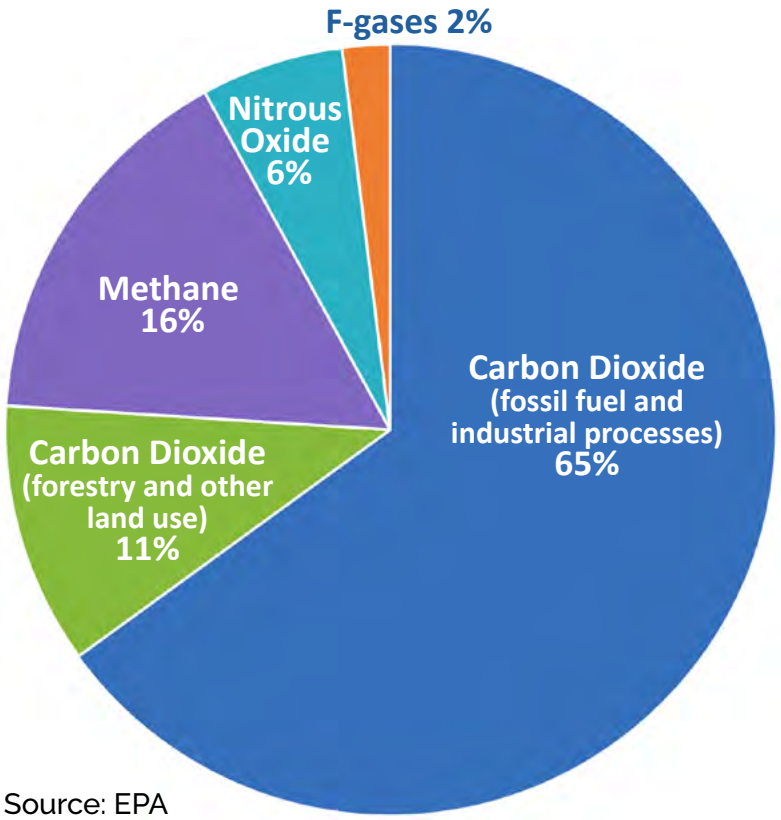
1. *The Battle for Coral Reefs* by Time for Kids, 04/14/2017
   https://www.timeforkids.com/g56/battle-for-coral-reefs-2/

2. *Two-thirds of glaciers on track to disappear by 2100, study finds* by Kids News, 02/13/2023
   https://www.kidsnews.com.au/environment/twothirds-of-glaciers-on-track-to-disappear-by-2100-study-finds/news-story/c92cd252ebd1224a8c0b9fae078443e7

Go to www.WorldPopulationHistory.org. Click "Explore the Map" on the entrance screen. The yellow and red dots represent populations of 1 million.

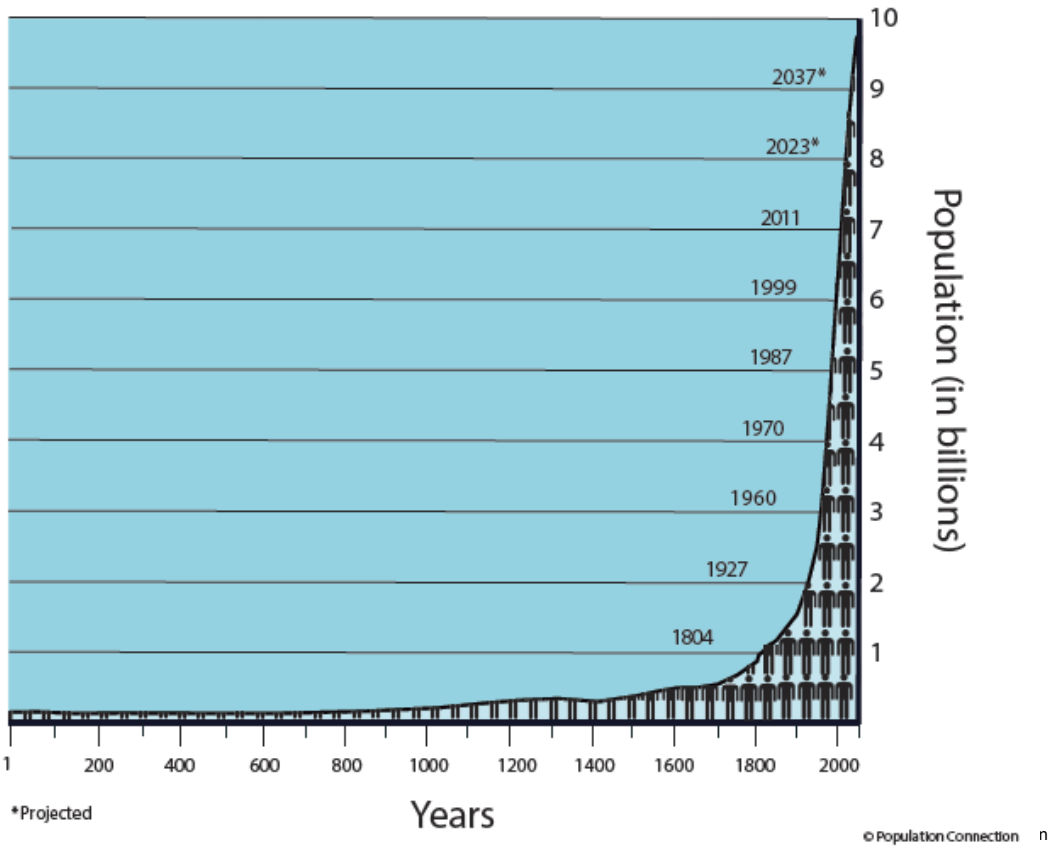


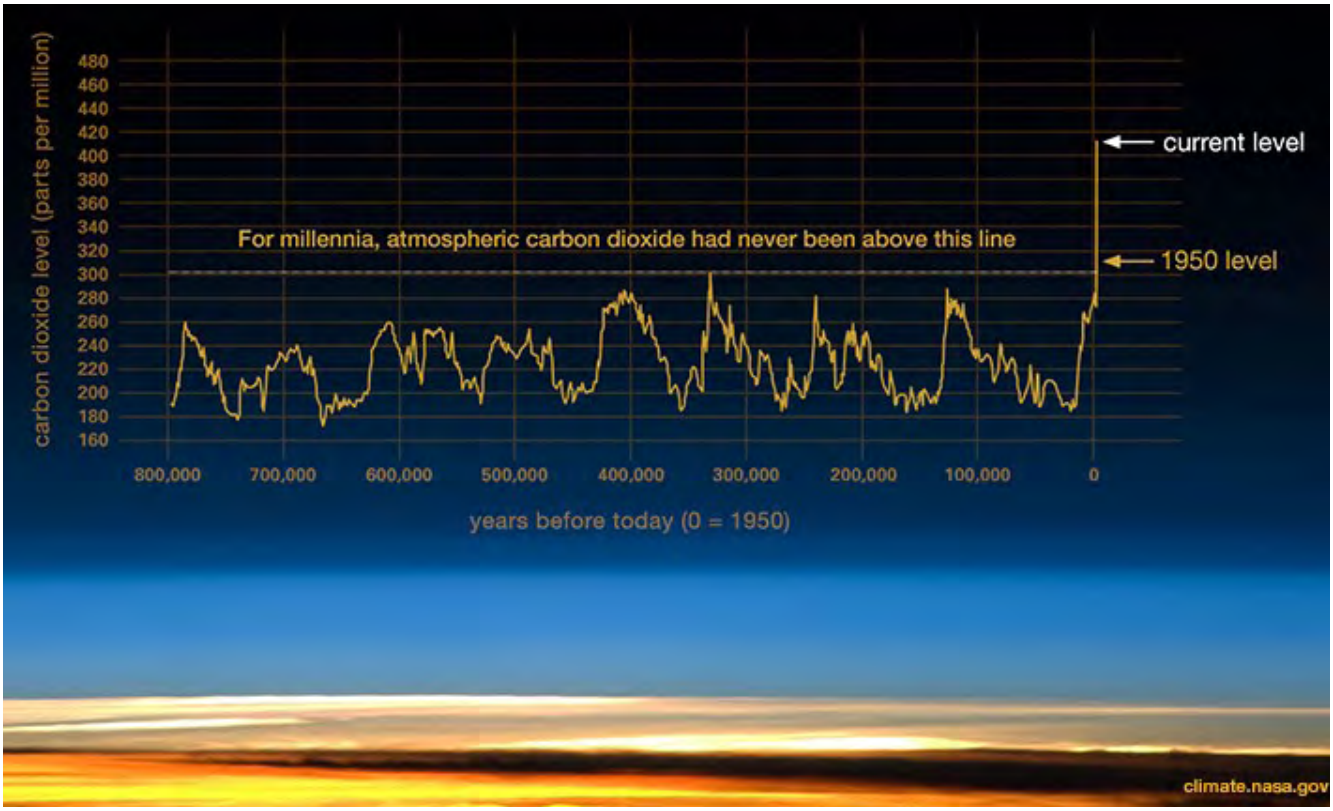
Global Greenhouse Gas Emissions by Gas



Source: EPA

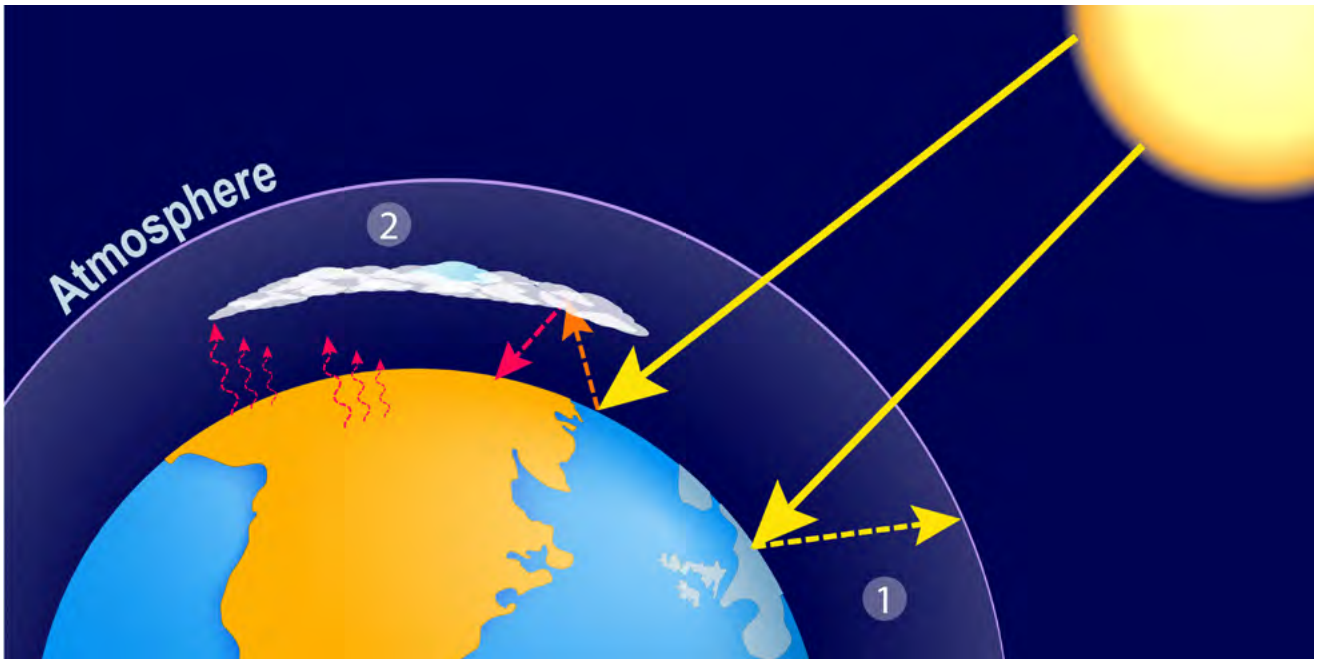
World Population 1 CE - 2050 CE





Source: NASA

This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO2 has increased since the Industrial Revolution. (Credit: Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO2 record.)



The greenhouse effect is thrown out of balance by too much human-made carbon dioxide. (1) Some sunlight that hits the Earth is reflected. Some becomes heat. (2) CO2 and other greenhouse gases in the atmosphere trap heat, keeping the Earth warm.

"Inuit Qaujimajatuqangit, the system of Inuit traditional knowledge and social values, is based on a long and close relationship with the land and environment. Interviews with elders, hunters and community members have added much to scientific research on climate change. Inuit observations have provided useful information at different time scales and levels of detail that have significantly contributed to our understanding of climate change in Nunavut."

- Nunavut Climate Change Secretariat

"We used to get more blizzards, really strong blizzards. But the blizzard season is fairly short (now). These days we are getting fewer blizzards but more, windy days." Jimmy Koomarjuk from Iqaluit

"Never know how the weather is going to be. So unpredictable nowadays." Bobby Algona from Kugluktuk

"I have noticed the changes and especially this last year. It has not really snowed at all this year. In that I mean a real snowstorm, and we have yet to experience a blizzard this winter. There are reports of blizzards on the radio, but that is only natiruviaq, a small blizzard, not a real one" Mosesee Joami from Iqualuit

"It is windier now and the change in the ice and water is faster now, it is a lot warmer now." Isaac Kalluk from Resolute Bay

"I have noticed from my younger days, as a hunter, especially the winters, there are extreme weather changes during the winter. The extreme cold followed by days of warmth." John Avaala from Baker Lake

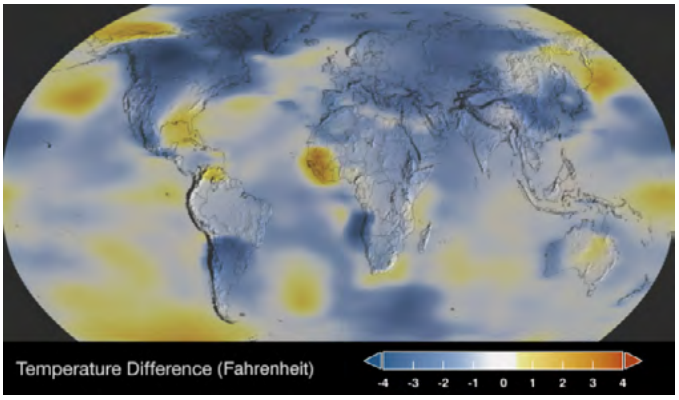
"It is much warmer now, even in winter. It used to be really cold in January and December but it is not so cold now. The temperature has changed." Isaac Kalluk from Resolute Bay

Source: Nunavut Climate Change Secretariat
www.ClimateChangeNunavut.ca

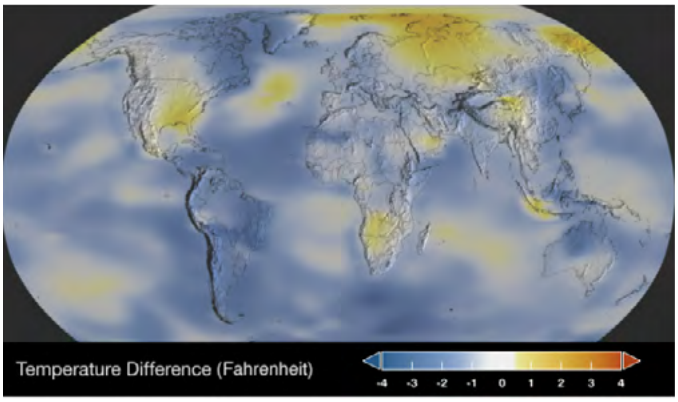
Temperature Anomaly (°C)

The time series below shows the five-year average variation of global surface temperatures from 1884 to 2020. Dark blue indicates areas cooler than average. Dark red indicates areas warmer than average.

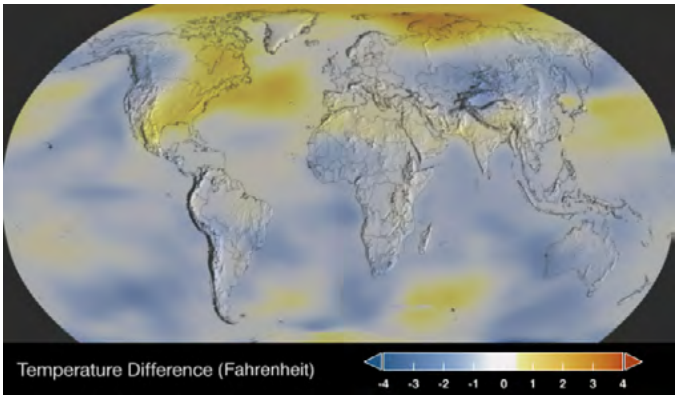
1884



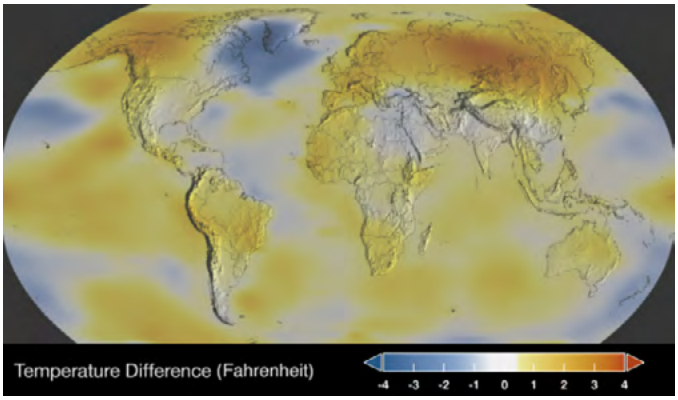
1925



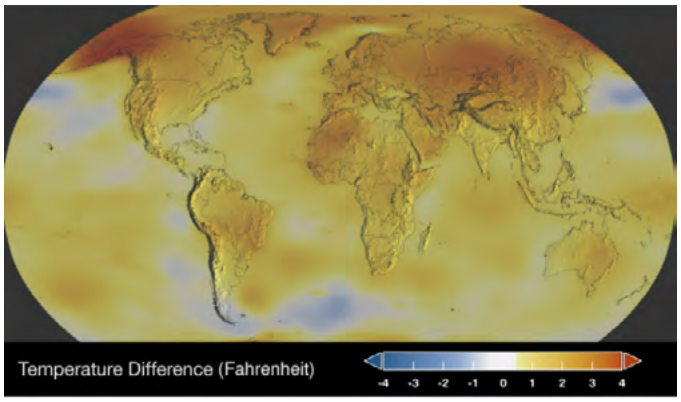
1955



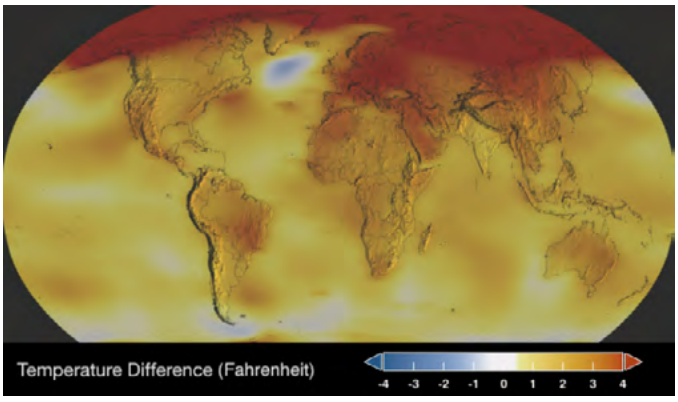
1995



2005



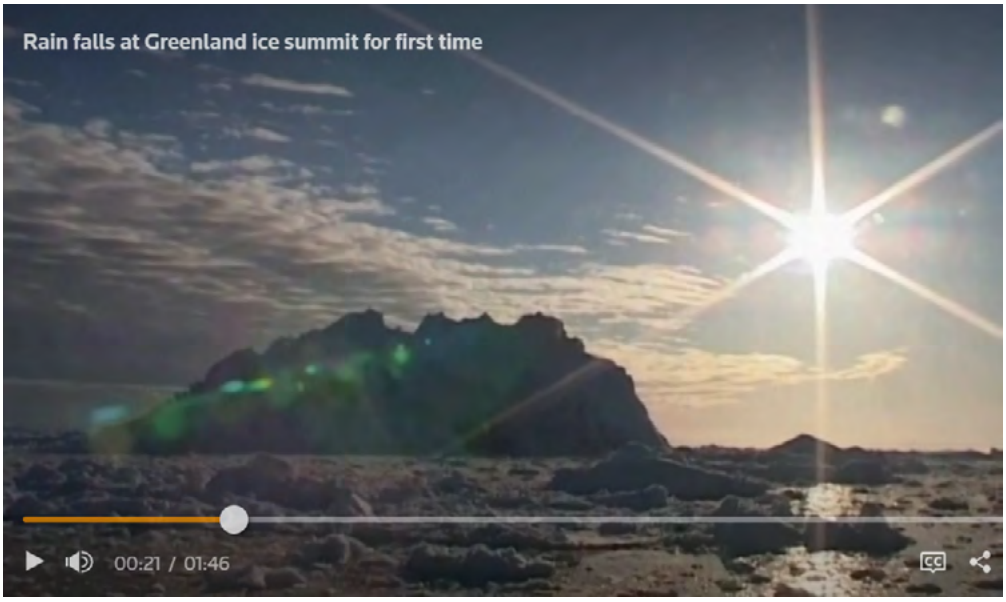
2020



Source: NASA

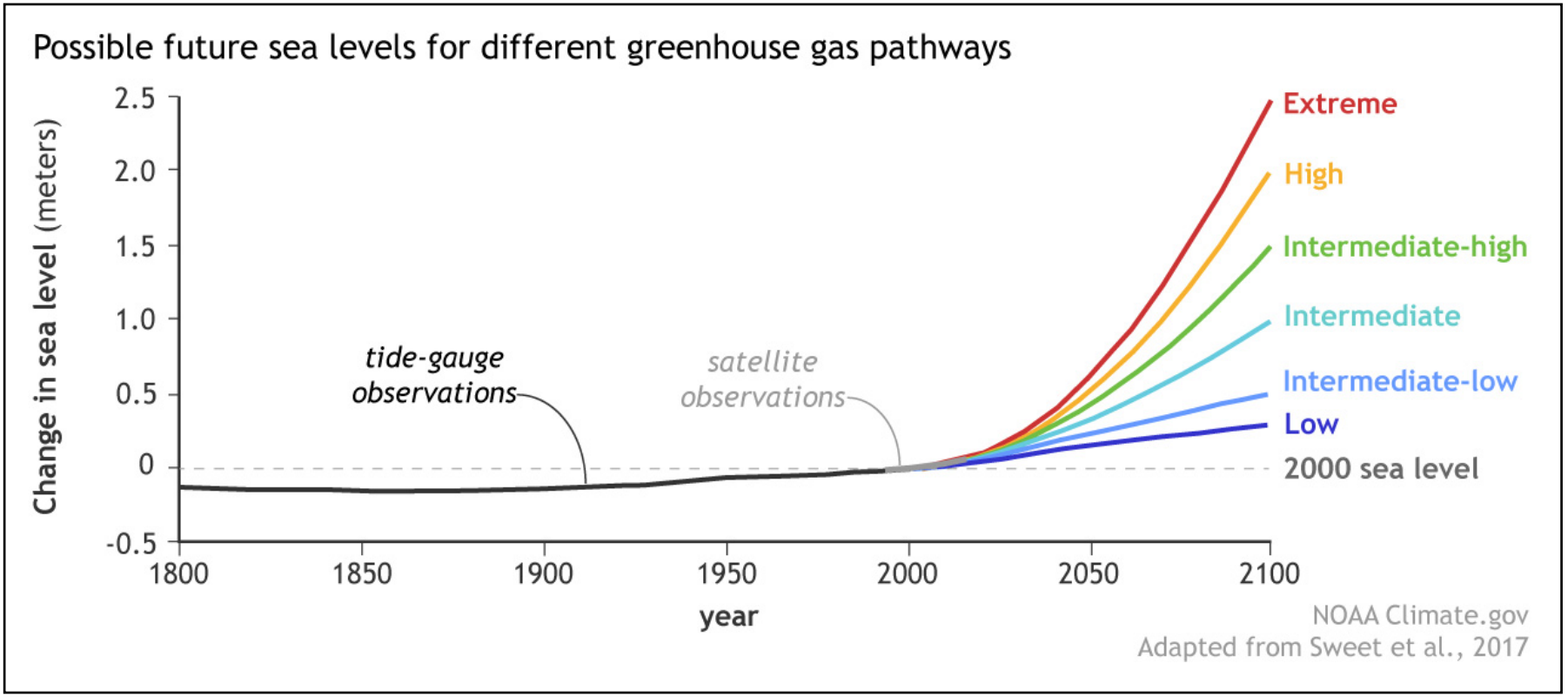
Rain falls at Greenland ice summit for the first time

Watch this short video from Reuters (August 21, 2021)
https://population.education/Greenland_Ice

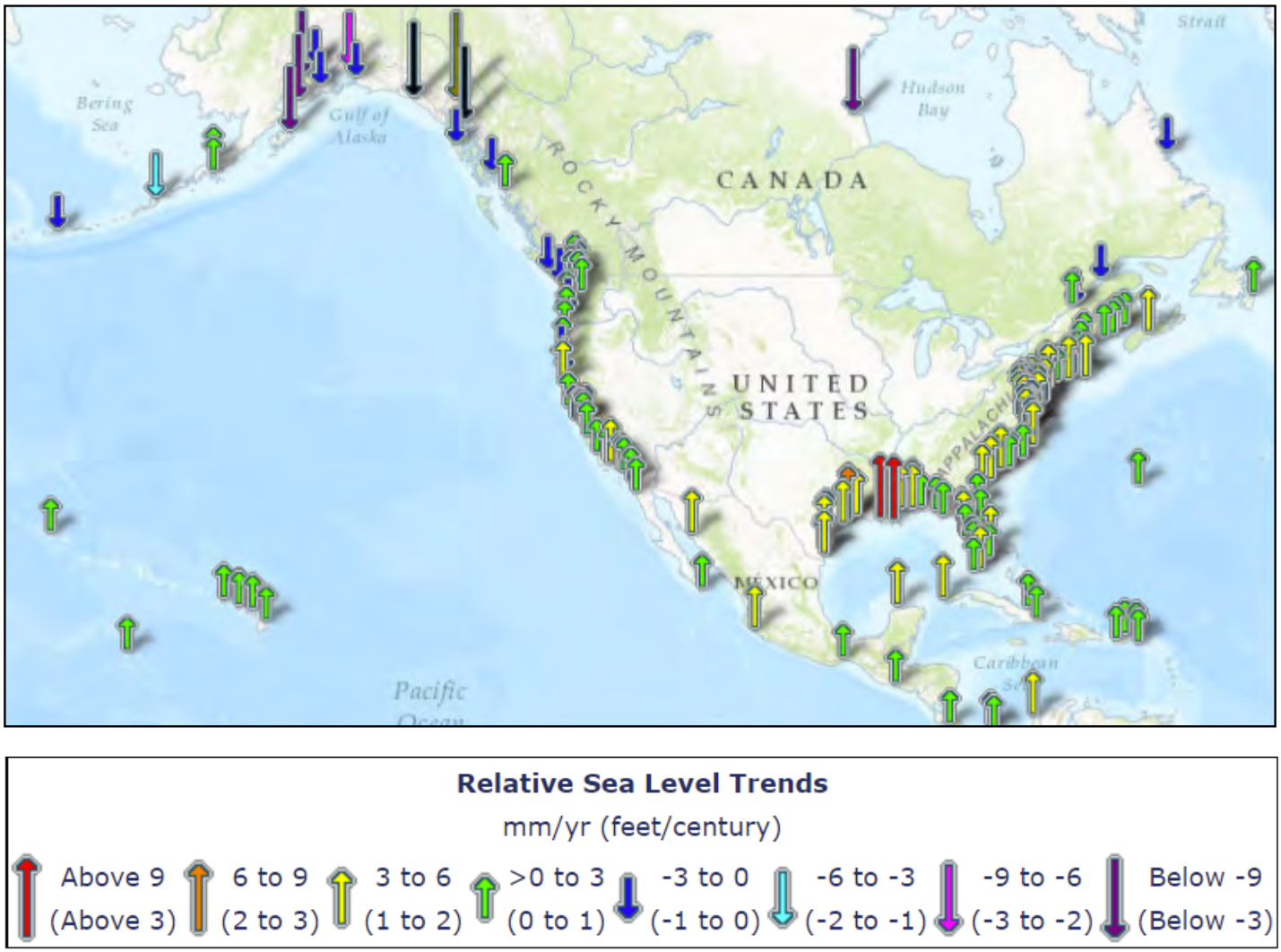


Rain fell at the highest point on the Greenland ice sheet last week for the first time on record, another worrying sign of warming for the ice sheet already melting at an increasing rate, scientists said on Friday.

A pair of photographs, both taken from the same location, of Muir Inlet, Glacier Bay National Park and Preserve, Alaska showing changes that have occurred to the Muir Glacier between August 13, 1941 and August 31, 2004.



Observed sea level from tide gauges (dark gray) and satellites (light gray) from 1800-2015, with future sea level through 2100 under six possible future scenarios (colored lines). The scenarios differ based on potential future rates of greenhouse gas emissions and differences in the plausible rates of glacier and ice sheet loss.



NOTES: The map above illustrates relative sea level trends, with arrows representing the direction and magnitude of change. "Global sea level has been rising over the past century, and the rate has increased in recent decades. In 2014, global sea level rise was 2.6 inches above the 1993 average – the highest annual average in the satellite record (1993-present). Sea level continues to rise at a rate of about one-eighth of an inch per year." – National Oceanic and Atmospheric Association (NOAA)

The Center for Operational Oceanographic Products and Services has been measuring sea level for over 150 years, with tide stations of the National Water Level Observation Network operating on all U.S. coasts. Changes in relative sea level, either a rise or fall, have been computed at 142 long-term water level stations using a minimum span of 30 years of observations at each location. This work is funded in partnership with the NOAA OAR Climate Observation Division.

Credit: Farid_Ahmed Stock Photo ID: 837803298

In August 2017, Bangladesh faced a serious humanitarian crisis when flood water covered a third of the country and forced thousands of people to flee. This photo was taken in the Manikganj district of Shibaloy where nearly all the houses were submerged. Northern India and Nepal also faced severe flooding. Much of the submerged land was devoted to crop production and livestock, leaving the region grappling with food shortages among other challenges.

PEOPLE AND CLIMATE CHANGE: THE DATA IS IN

STUDENT WORKSHEET

Go to www.WorldPopulationHistory.org**. Click "Explore the Map" on the entrance screen. The yellow and red dots represent populations of 1 million.**

1. How many dots are in South America? What was the population of South America in 1 C.E.?

_____

From the "Overlays" dropdown menu, select "Fossil Fuel CO2 Emissions."

2. Next to the title in the dropdown, Fossil Fuel CO2 Emissions, is the date range 1751-2010. What do you think this means?

_____

_____

_____

Look at the "Year" box at the top right of the screen. It should now show the year 1751. Click the triangle play button above the timeline on the bottom right of the screen to see how population and CO2 emissions changed between 1751 and 2010.

3. What happens to population between 1751 and 2010?

_____

_____

4. What happens to CO2 emissions between 1751 and 2010? How do you know?

_____

_____

_____

5. How are population and CO2 emissions related? Why do you think this is true?

_____

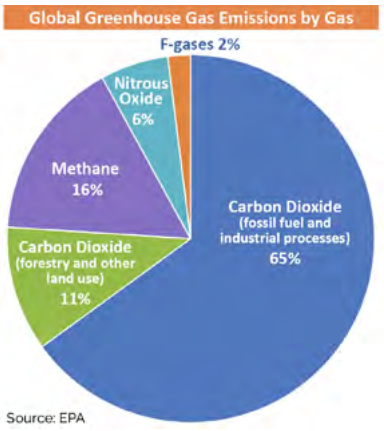
_____

_____

Theme: _____

1. Circle the title of the graph on the image at the right.

2. What type of greenhouse gas is emitted the most worldwide?



3. What human activities contribute CO2 to the atmosphere? Hint: look at the graph for clues.

4. Is a pie chart a good way to represent this data? Why or why not?

Theme: _____

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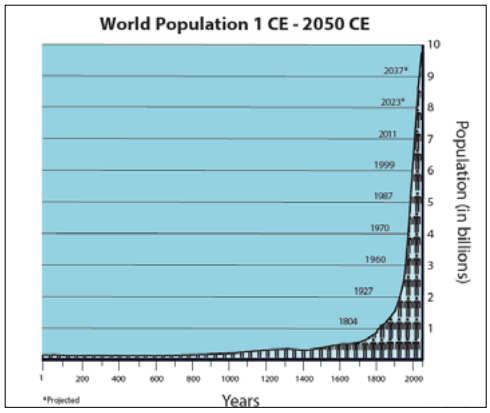
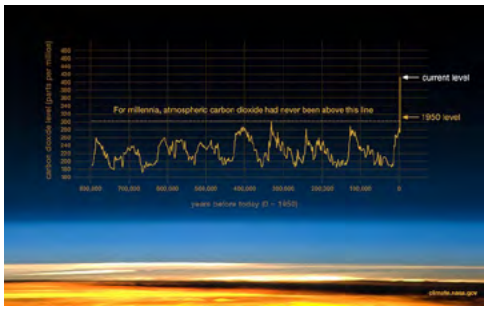
1. The graph starts in the year 1 C.E. How many years did it take for population to reach 1 billion people?

2. It took 123 years for population to grow from 1 billion to 2 billion people. How long did it take to grow from 6 billion to 7 billion people? What does this tell you about the rate of population growth?



Theme: _____

1. Which greenhouse gas is being graphed?



2. What time period is represented by this graph?

3. What is this graph's main take-away?

4. Is this a compelling piece of information? Why or why not?

5. Give this graph a title.

Theme: _____

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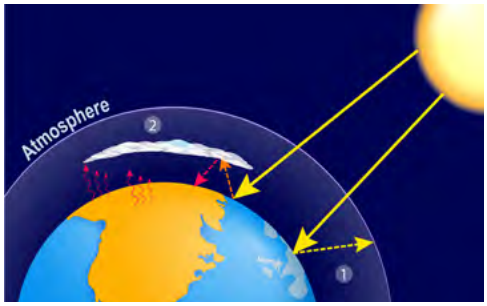
1. Draw an arrow pointing to where greenhouse gases are located in the diagram at the right.

2. Why is the phenomenon shown here called the greenhouse effect?



3. How does CO_2 in the air contribute to Earth's warming? Use the diagram and the text below it for clues.

4. What human activities do you know of that contribute to CO_2 in the atmosphere?

Theme: _____

1. Why are the coral reefs in the article dying?

The Battle for Coral Reefs

2. What purpose do coral reefs serve?

3. What additional information would you like to know after reading this article?

4. Do you think the article is discussing a causative relationship or correlative relationship? Explain.

Theme: _____

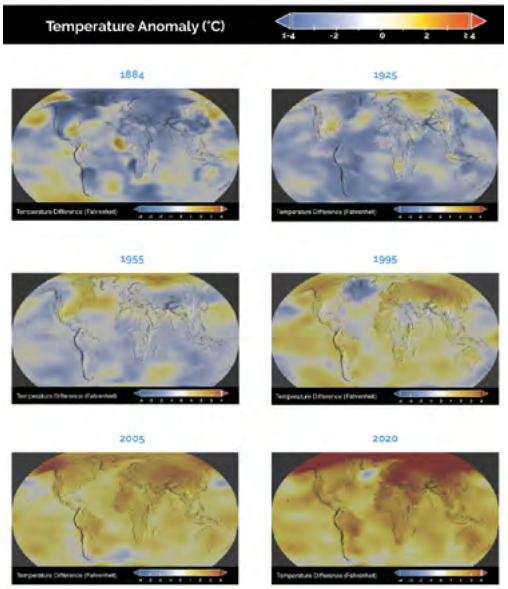
1. Why is listening to Inuit voices useful in understanding climate change?

2. What further questions do you have about this information?

3. What are the benefits of including personal stories in climate data? What are the drawbacks?

Theme: _____

1. What was the trend from 1884-1955?



2. What is the trend in the last 25 years of data?

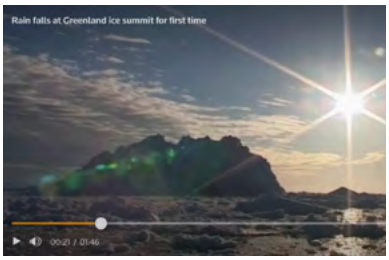
3. What color do you think will be most represented on the map in 20 years?

4. What are the benefits of viewing temperature data in this format? What are the drawbacks?

5. How else could this data be portrayed?

Theme: _____

1. When was the last time Greenland saw rain?



2. According to the scientist, how is a change of a couple degrees in Greenland different from a change of a couple degrees in the mid-latitudes?

3. What would you say is the main point of the video?

Theme: _____

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1. The article says that if the temperature continues to rise at this rate, 68% of glaciers will melt causing sea levels to rise 11.5 cm. Why do melting glaciers on land lead to sea level rise?


Two-thirds of glaciers on track to disappear by 2100, study finds

The world's glaciers are melting faster than scientists thought, with two-thirds on track to disappear by the end of the century, according to a new study.

AP

1 min read · February 13, 2023 · 6:30PM · Kids News

2. What are two ways that melting glaciers can impact humans?

3. What does the article point to as the driving cause of melting ice?

4. What sentence from the article do you think is the most compelling? Write it below.

Theme: _____

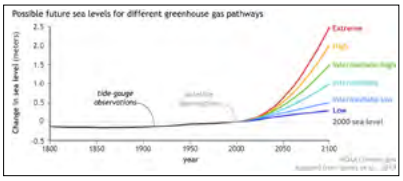
1. How many years passed between the first and second picture?

2. What do you think caused the glacier to retreat so rapidly?

3. Give this set of images a catchy title.

Theme: _____

1. What is being measured on the y-axis and what is the unit of measurement?

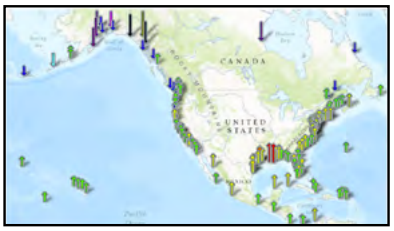


2. What do the different colored lines and the labels "Extreme," "High," Low," etc. represent?

3. What factors do you think scientists consider when making predictions about sea level rise? Hint: use the text beneath the graph for help.

Theme: _____

1. What is this map showing?



2. What do you think "changes in relative sea level" means?

3. What sentence in the notes best helps you understand this map? Write it here.

Theme: _____

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1. How does this image make you feel?

2. What are benefits of getting information from photographs? What are drawbacks?

3. What other areas have you heard of that will most likely see flooding due to sea level rise?

Theme: _____

PEOPLE AND CLIMATE CHANGE: THE DATA IS IN

STUDENT WORKSHEET ANSWERS

Population and Greenhouse Gasses

Carbon emissions and population growth (1751-2010)

1. *2 dots. 2 million people.*
2. *This means that the data begins in the year 1751 and ends in the year 2010.*
3. *Population increases rapidly.*
4. *CO2 emissions increase. Starting in the late 19th century, we see the first CO2 emissions 'bubble.' Many more 'bubbles' appear quickly, including some that are red, indicating the highest CO2 emissions.*
5. *As population increases, so does CO2 emissions. Population growth coupled with industrialization creates more CO2 emissions as a result of human actions like factory production and transportation.*

Greenhouse gas emissions by gas

1. *Students should circle 'Global Greenhouse Gas Emissions by Gas'*
2. *Carbon dioxide (CO2)*
3. *Industrial processes and fossil fuel use*
4. *Answers will vary.*

J-curve of human population growth (1 C.E.-2050)

1. *1804 years*
2. *12 years; the rate of population growth has been much faster recently than in the past.*

CO2 levels over the past 4,000,000 years

1. *Carbon dioxide (CO2)*
2. *800,000 years ago through present day*
3. *The CO2 levels we are seeing today are much higher than what has been experienced over the past 800,000 years.*
4. *Answers will vary.*
5. *Answers will vary.*

Temperature Rise

Greenhouse effect diagram

1. *Students should draw an arrow pointing toward the long, thin white graphic under the number 2 on the diagram.*

2. *Greenhouse gasses trap heat in the Earth's atmosphere, thus warming the Earth. This is similar to how heat becomes trapped inside the glass walls of a greenhouse.*

3. *CO2 absorbs heat, preventing it from being reflected back into the atmosphere.*

4. *Human activities like driving and other forms of transportation, industrial production, residential activities like heating, cooling, and electricity use, and agricultural practices all contribute to CO2 in the atmosphere.*

Article: The Battle for Coral Reefs

1. *The coral reefs researched for this article are dying because they are becoming bleached as a result of warming water temperatures.*

2. *Coral reefs are home to one-fourth of the species that live in the ocean. They also act as barrier to keep the full force of storms from hitting the coast.*

3. *Answers will vary.*

4. *A scientist in the article says "If temperatures keep rising, we'll see bleaching on most reefs around the world," which indicates a causative relationship. Students can use other quotes from the article to indicate this relationship.*

Inuit quotes on change in Nunavut, Canada

1. *Answers will vary. Students may mention traditional Inuit values of a relationship with the land, observations of change over generations, the disproportionate impact of warming on the Inuit way of life, etc.*

2. *Answers will vary.*

3. *Benefits can include: personal stories can bring data and information about climate change to life, generating an emotional connection and ultimately making it more powerful. Drawbacks can include: it may be difficult to find trends and patterns or draw conclusions if perspectives include only a small sample size.*

Global temperature maps (1884-2020)

1. *The map is mostly blue with some yellow and a small amount of orange. Global temperatures didn't change drastically.*

2. *The maps are mostly yellow with an increasing amount of orange, dark orange, and in the last map, red. Global temperatures are warming and increasing.*

3. *Answers will vary, but students will likely say dark orange or red based on the trend.*

4. *Benefits can include: it is very visual and the colors make it easy to see changes and trends; seeing the data over a world map highlights the global nature of climate change; you can see how temperature trends differ geographically. Drawbacks can include: the data is less specific/detailed than it would be in graph or chart form; there are many years that aren't displayed in this data.*

5. *Answers will vary.*

Land Ice Melt

Video: Rain falls at Greenland ice summit for first time

1. *Never. This was the first time rain was recorded in Greenland since records began in 1950.*

2. *The scientist points out that the difference of just a few degrees in the arctic is the difference between swimming and ice skating.*

3. *Answers will vary.*

Article: Two-thirds of glaciers on track to disappear by 2100, study finds

1. *Melting ice (on land) leads to sea level rise because the melting ice releases water that flows into the ocean and adds volume. (Sea ice melt does not contribute to sea level rise).*

2. *Any two of the following: In many parts of the word, water from glaciers is an important source of drinking water, provides a supply of agricultural water, and is used for hydroelectric power. When glaciers disappear or shrink in size, there is less water available for these uses. If sea levels rise to the projected amount, more than 10 million people around the world would be living below the high tide water level.*

3. *The article says rising global temperatures and human-created climate change are the cause of melting ice.*

4. *Answers will vary.*

Muir Glacier before (1941) and after (2004)

1. *63 years passed between the two photos.*

2. *Rising temperatures.*

3. *Answers will vary.*

Sea Level Rise

Past and projected changes in global sea level rise (1800-2100)

1. *The y-axis is showing change in sea level, measured in meters.*

2. *The different colors/lines indicate the amount of sea level change in different scenarios of greenhouse gas emissions – ranging from extreme emissions to low emissions.*

3. *Scientists consider trends in greenhouse gas emissions and rates of land ice melt (glaciers and ice sheets). Another factor that impacts sea level rise and is taken into consideration is sea expansion from rising water temperatures.*

Relative sea level trends; U.S. and Canada

1. *Relative sea level changes in the U.S. and Canada in mm/year and feet/century.*

2. *Relative means the change in sea level from the starting point of observations (a minimum span of 30 years at each location).*

3. *Answers will vary.*

Flooding in Bangladesh

1. *Answers will vary.*

2. *Benefits can include: photographs personalize information and can make it more emotionally powerful or memorable. Drawbacks can include: it can be challenging to observe trends or draw conclusions with only the narrow sample of information a photograph provides (in this case, an experience from a single place).*

3. *Answers will vary.*

IN THE NEWS: RESEARCH FOR TOMORROW

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

With a global population of close to 8 billion, one cannot ignore the far-reaching impact of our numbers on virtually every aspect of life on Earth. Our global family is projected to grow to over 9 billion by 2050. Dealing with population related issues like waste, poverty, climate change, and migration will only become more challenging in the years ahead. Looking at current events can help students understand these issues and can assist them in making educated guesses about what the future may hold and how their actions today might impact it.

MATERIALS

- Butcher paper
- Sticky notes
- Snapshot Summary Sheet (provided)
- Project Rubric (provided)
- Props to create mock newsroom environment (optional)
- Smartphone/tablet with video

PART 1: THE FUTURE AND ME PROCEDURE

1. At the beginning of class, give each student a sticky note. Allow students a few minutes to answer the following question on their sticky note: "Should youth today care about what happens 50 years in the future? Why or why not?"

2. Based on their answer, direct students to place their sticky notes on one of four large sheets of butcher paper displayed around the classroom. These sheets should be labeled "Yes," "No," "Maybe," and "Need More Information." Afterward, ask students to do a quick gallery walk to view some of their classmates' responses.

CONCEPT

Human population growth and its accompanying environmental impact can have far reaching implications on society, both today and in the future.

OBJECTIVES

Students will be able to:

- Discuss potential impacts of current population and environmental trends on their future lives.
- Research and summarize news articles about social and environmental trends related to population growth.
- Synthesize research into a fact-based, coherent presentation.
- Clearly communicate fact-based environmental and societal predictions for the future verbally and/or in writing.

SUBJECTS

Social studies (geography, history, economics), science (Earth and environmental), English language arts

SKILLS

Summarizing, making predictions, communicating, reading comprehension, writing a script

METHOD

Through planning, writing, and performing a news telecast, students use information from current events articles to create fact-based predictions about what their futures might look like.

3. Once students return to their seats, lead a debrief discussion asking questions like, "What were the most popular responses? Were there any common themes among the answers given? Was there anything that your classmates wrote that surprised you?" At this point, you may want to introduce the idea of collecting current events articles and the news telecast project that will follow.

PART 2: NEWS AND VIEWS PROCEDURE

Part 2 assumes that students know how to identify and evaluate valid news sources. For best practices to support your students' evaluation skills, visit Edutopia's blog Evaluating Quality of Online Info.

1. Assign students a subject from the list below. Make sure there are 3-4 students focusing on each topic you assign, as these will also be their groups for the news telecast in Part 3.

2. Explain to students that over the next two weeks, either during class or as homework, they are each responsible for locating 2-3 current events articles that deal with their topic. They should bring in 1-2 articles a week – this will help reduce the number of articles about the same current event.

   Subjects may include, but are not limited to, the following:

   Air Pollution
   Climate Change
   Deforestation
   Endangered Species
   Environmental Justice
   Food Resources/Hunger
   Housing/Homelessness
   Immigration
   Land Use
   Population Growth
   Public Health
   Resource Use/Consumption
   Waste Management
   Water Pollution
   Water Resources

   Depending on their reading level and age, you may want to provide students with preselected, age-appropriate current events websites.

   Suggested Websites:
   Newsela https://newsela.com
   DOGO News https://www.dogonews.com
   Time for Kids https://www.timeforkids.com
   Student News Daily https://www.studentnewsdaily.com
   Smithsonian Tween Tribune https://www.tweentribune.com
   National Geographic https://www.nationalgeographic.org/education/

3. After the first week, use an article of your choice to model how students should summarize their articles using the Snapshot Summary Sheet. Point out that the title does not get recorded on the Summary Sheet. (Students will partake in an activity later on that requires them to create article headlines.) As a class, practice summarizing a second article.

4. Have students independently summarize the articles they have already brought in. From this point on, students should write a summary of each subsequent article they locate using the Snapshot Summary Sheet and submit both the article and summary to you.

5. When the class is done bringing in articles and completing summaries, randomly hand out 2-3 Snapshot Summary Sheets to each student. Students should use the information on the Snapshot Summary to create a headline for the article.

PART 3: LIGHTS, CAMERA, ACTION!

PROCEDURE

1. Explain to students that they are going to produce a class news telecast that reports on stories from around the world related to population, environmental, and social trends. Distribute the Project Rubric and describe how they will be evaluated.

2. Divide students into news teams of 3-4 people, based on the current event topic they researched in Part 2. No two news teams should have the same topic.

3. Pass out all of the Snapshot Summary Sheets related to the topic each student news team is covering. You may want to provide them with the original articles from which the summaries were written as well.

4. First individually and then as a group, students should use the information they have learned in class, the Snapshot Summaries handed back to them, and any additional resources you provide to answer the following questions:

    a. Who or what is being impacted by your topic right now? According to the Snapshot Summaries you read, what is currently happening? Give at least three related facts in your answer.
    b. Has your topic been an issue for our country or the world in the past? If so, for how long? If not, why do you think it is becoming an issue now?
    c. Think of the world 20 years in the future. Will this topic still be an issue? Why or why not? What can we do to prevent this from still being an issue?
    d. Think of the world 50 years in the future. Will this topic still be an issue? Why or why not? What can we do to prevent this from still being an issue?

5. Within each group, students should decide if their main role will be a writer or a reporter. While they do have some choice in their main role, all students are expected to participate in the writing of the script and play some role in the production of the news story.

6. Groups should write scripts that answer the four questions in step 4 and give a coherent account of both the current state of their issue and predictions for what will happen in the future. News teams should plan for their segment of the telecast to run between one and two minutes.

7. Give student news teams time to practice presenting their story. If students are not familiar with the format of a nightly news broadcast, it might be helpful to share a few examples so they can see how news shows and segments are structured. Each group should be ready to perform their news story for the class and have it recorded.

8. Pick two students to act as anchors for the class news telecast. The anchors will introduce each news team who will then present their story.

9. Take class time to watch the recorded news telecasts from other classes. As students watch other groups' news segments, have them provide one piece of positive feedback and one idea for improvement on a piece of paper.

ASSESSMENT

Use the Project Rubric to evaluate students' success in completing the project.

FOLLOW-UP ACTIVITY

Students write a letter to a friend, dated 40 years from today. Before writing the letter, students should consider how their own life might change in the future as a result of population growth and the issues that come along with it. The letter can address what is better or worse about their future life, where they live, what their neighborhood is like, what their job is, how people in the future get around, and other related details.

SNAPSHOT SUMMARY

Name: _____ Date: _____

A summary is a short account of the central idea of a text. Please fill in the following details about your chosen article, answer the six questions, and then write 2-3 sentence summary.

Date article was published: _____

Your topic: _____ Article source: _____

1. Who was the article about? _____

_____

2. What caused the event in this article to happen? _____

_____

3. Where does the article take place? _____

_____

4. When did this event happen? _____

_____

5. Why did it happen? _____

_____

6. How did it happen? _____

_____

My Article Snapshot Summary: _____

_____

_____

_____

_____

_____

_____

IN THE NEWS: RESEARCH FOR TOMORROW

PROJECT RUBRIC

Name: _____ Date: _____

Group Members: _____

Topic: _____

In order to be ready for the news cast, your group's script will need to include ALL the following components (please check off each box as you go along):

- ☐ Introduction of all group members acting as reporters.
- ☐ Three clearly stated facts about the current status of your issue.
- ☐ Any related historical background learned from articles or Snapshot Summaries.
- ☐ Prediction of issue status/impact on society in the future.
- ☐ At least one proposed solution or actionable item to help society with the issue.
- ☐ Closing statements or thoughts.

IN THE NEWS: RESEARCH FOR TOMORROW

PROJECT RUBRIC - PAGE 2

RUBRIC	Basic	Emerging	Proficient	Exceeds
	1	2	3	4
Use of Class Time How well did **you** use your work time?	Group member is frequently off task and needs a significant amount of reminders to get back to work.	Group member is sometimes off task and needs multiple reminders to get back to work.	Group member is on task the majority of the time and helps other members with minimal reminders.	Group member is on task the entire time and helps other members without being asked.
Task Leadership Did **you** assist with one of the two major project tasks?	Group member needs several reminders to assist with major news segment task OR does nothing to help the group complete them.	Group member needs multiple reminders, but plays main role in either writing OR presenting news segment	Group member plays main role in either writing OR presenting news segment.	Group member plays main role in writing AND presenting news segment.
Writing Task Completion Did **your group** complete the assignment?	Two or less major parts of the script were included.	At least four major parts of the script were included.	All six major parts of the script were included.	All six major parts of the script were included, with at least two proposed solutions or actionable items.
Presentation What was **your group's presentation** like?	Only one group member spoke, the presentation was less than one minute, and/or the information was not presented in a coherent sequence.	At least two group members spoke, the presentation was 1-2 minutes, but information was not presented in a coherent sequence.	The majority of group members spoke, presentation was 1-2 minutes, and information was presented in a mostly coherent sequence.	All group members spoke, presentation was 1-2 minutes, and information was presented in a coherent sequence.

TOTAL SCORE: _____/16