

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 320 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 disproportionately 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 NSF'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 .gov, .edu, or .com website.
 - 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 Understanding Fracturing Fluid infographic with them, and going through the questions. Use student input to help fill it out and have them follow along on their own Source 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)? *Canary*

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

Biased for fracking because their goal is to sell equipment to fracking companies and to help them make a profit while fracking.

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.

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.

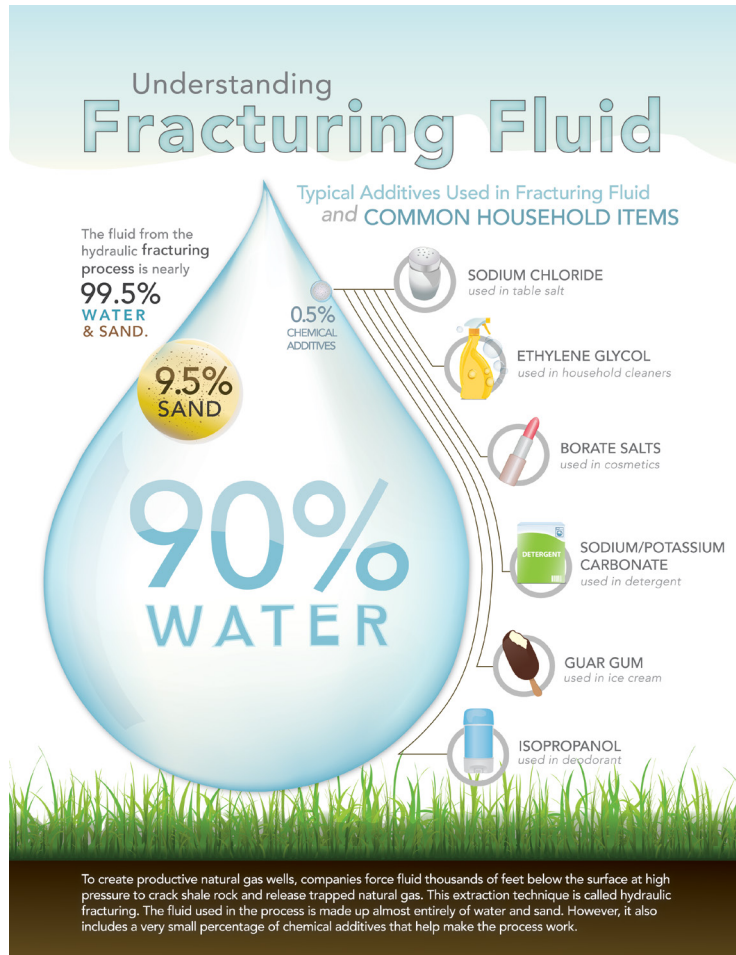
Write one full sentence summarizing what this artifact is showing. Are there any patterns or interesting details?

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

GALLERY WALK ARTIFACTS

TEACHER EXAMPLE ARTIFACT:

UNDERSTANDING FRACTURING FLUID INFOGRAPHIC



Source: Canary, October, 2014. <http://canaryusa.com/frac-fluid-ingredients/>

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

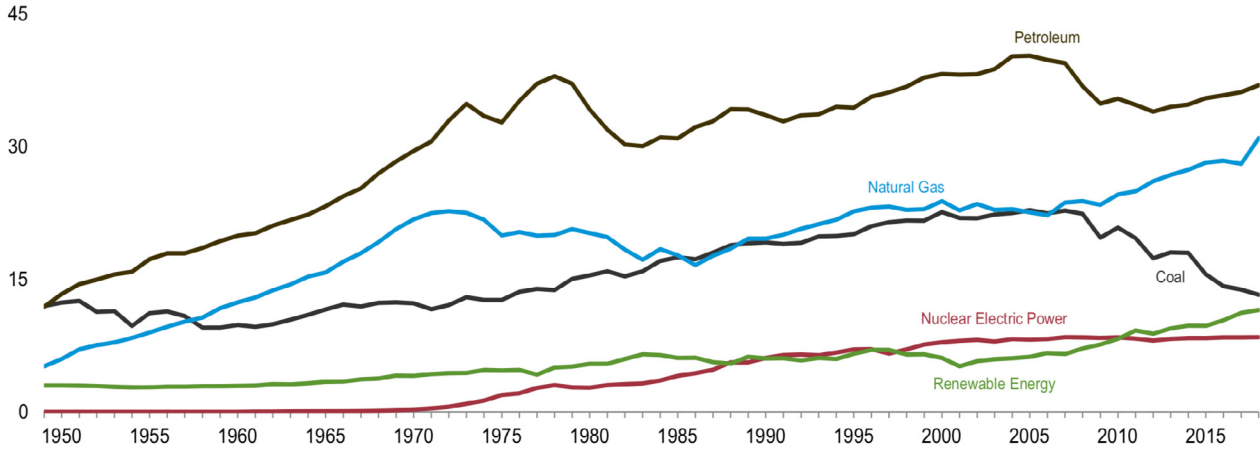
About the source: "Canary, LLC is one of the largest and most experienced national providers for your oilfield service needs. We use cutting edge technology and hard won experience to help our customers produce domestic energy while still making a profit. Our integrated approach provides the highest quality wellhead and hydraulic fracturing equipment & service. Our unsurpassed pressure testing services help our customers complete their wells on time and on budget. We pair cutting edge technology with our proven team of experts to help our customers operate safe, successful wells across the United States."

"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)

By Source, [a] 1949–2018



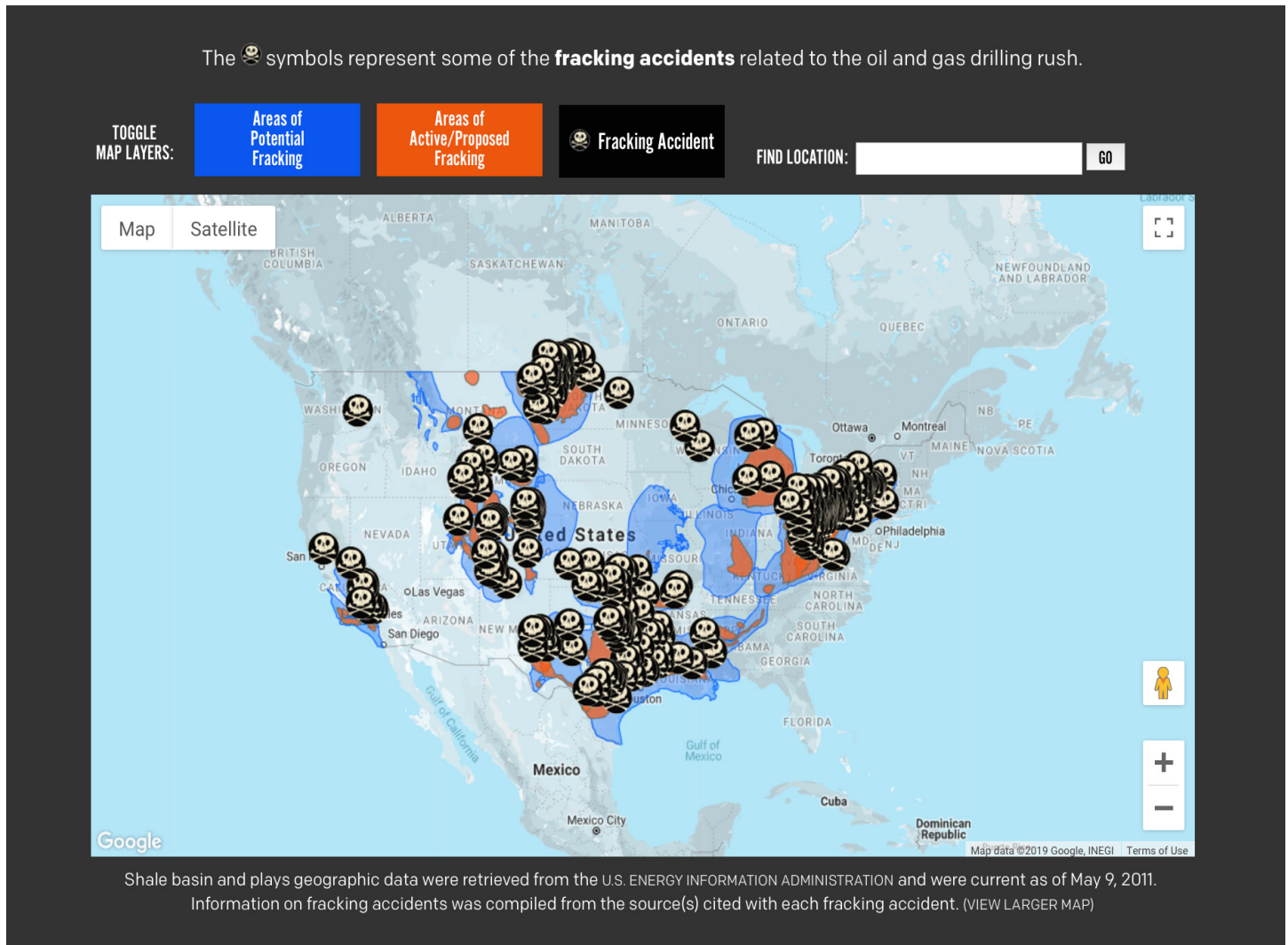
By Source, [a] Monthly

Source: Monthly Energy Review September 2019, United States Energy Information Administration.
<http://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 #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):



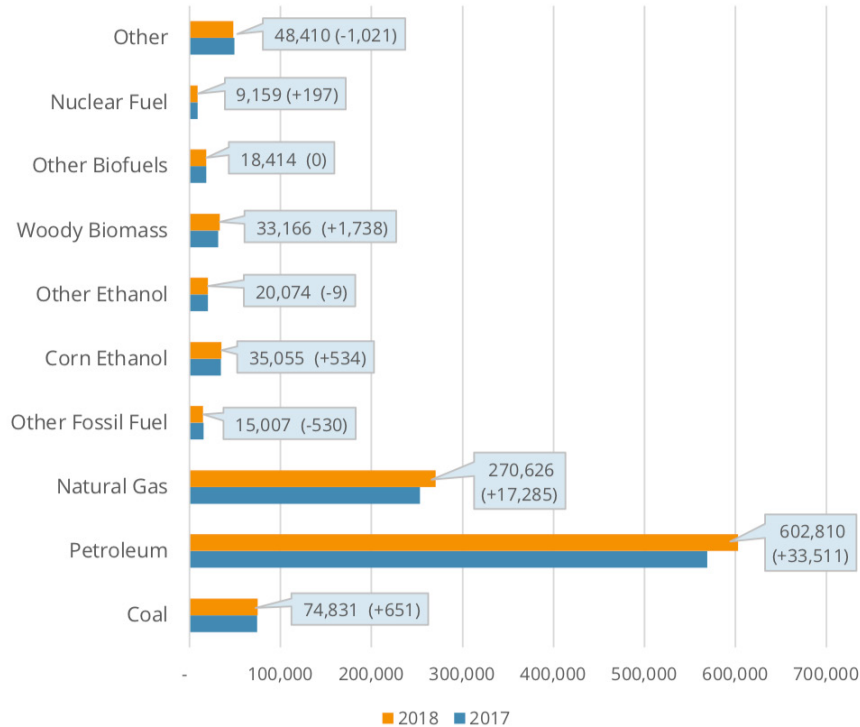
Caption: The United States is in the midst of an unprecedented oil and gas drilling rush—brought on by a controversial technology called hydraulic fracturing, or FRACKING. Along with this fracking-enabled rush have come troubling reports of poisoned drinking water, polluted air, mysterious animal deaths,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

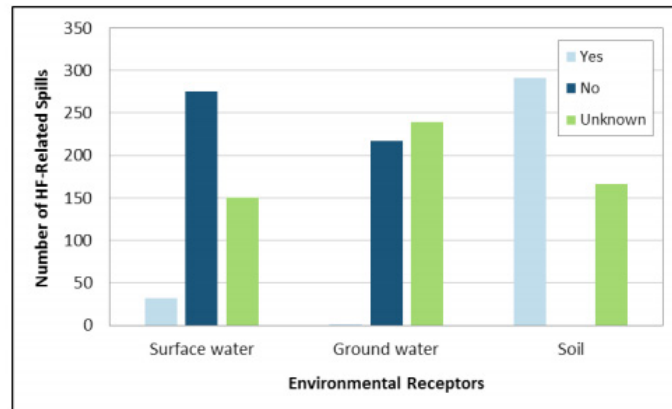


Figure 8. Number of hydraulic fracturing (HF)-related spills in which spilled fluids reached (yes) or did not reach (no) surface water, ground water, or soil. “Unknown” refers to hydraulic fracturing related spills for which environmental receptors were specified as unknown or were not identified.

Table 9. Number of hydraulic fracturing-related spills, total reported volume spilled, and reported volume per spill by environmental receptor. There were 300 hydraulic 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 receptors. Therefore, the number of receptors reached sums to 324. “NA” indicates “not applicable.”

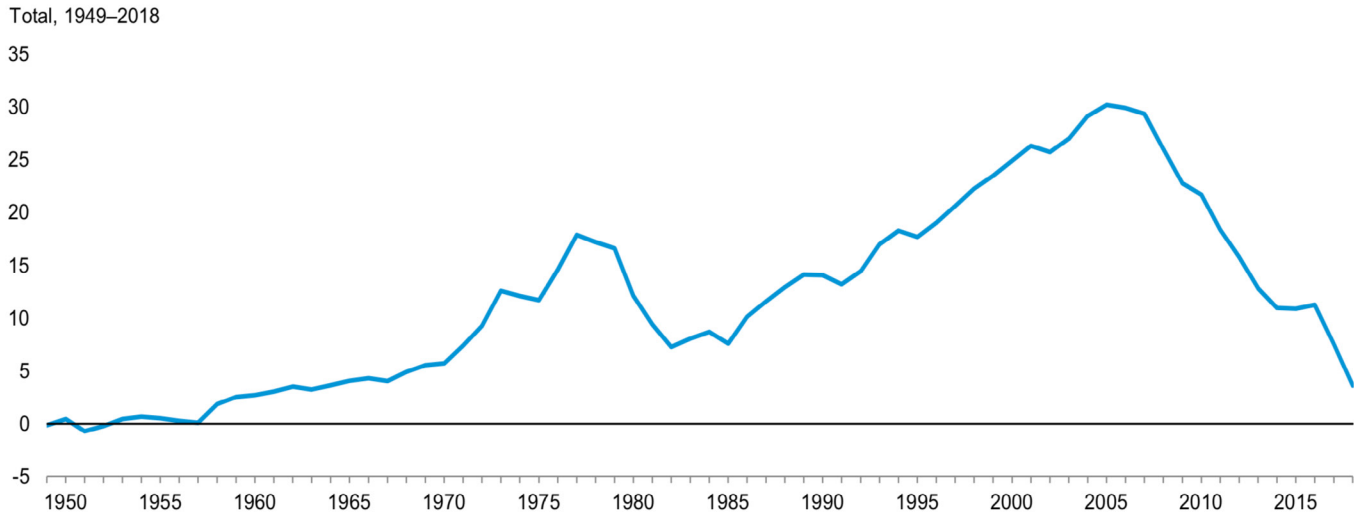
Environmental Receptor	Number of Spills	Total Reported Volume Spilled (Gallons)
Soil	291	540,000
Surface Water	32	200,000
Ground Water	1	130

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.

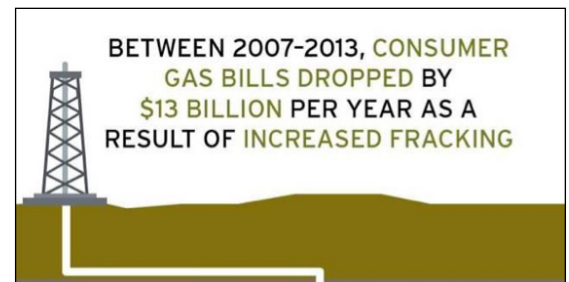
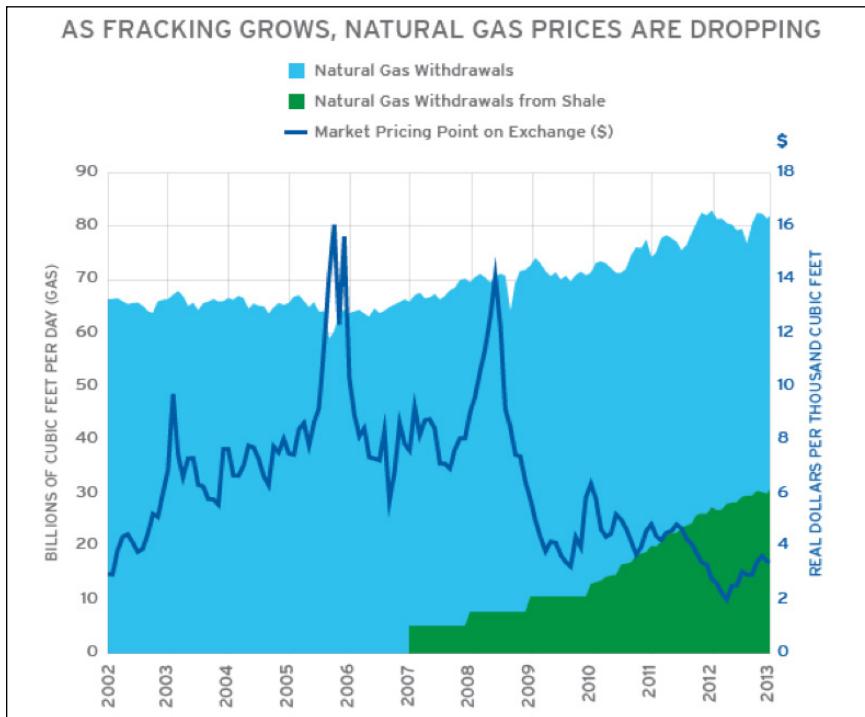
"I don't want to destroy our water," Alcon said. "You can't drink oil."

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.

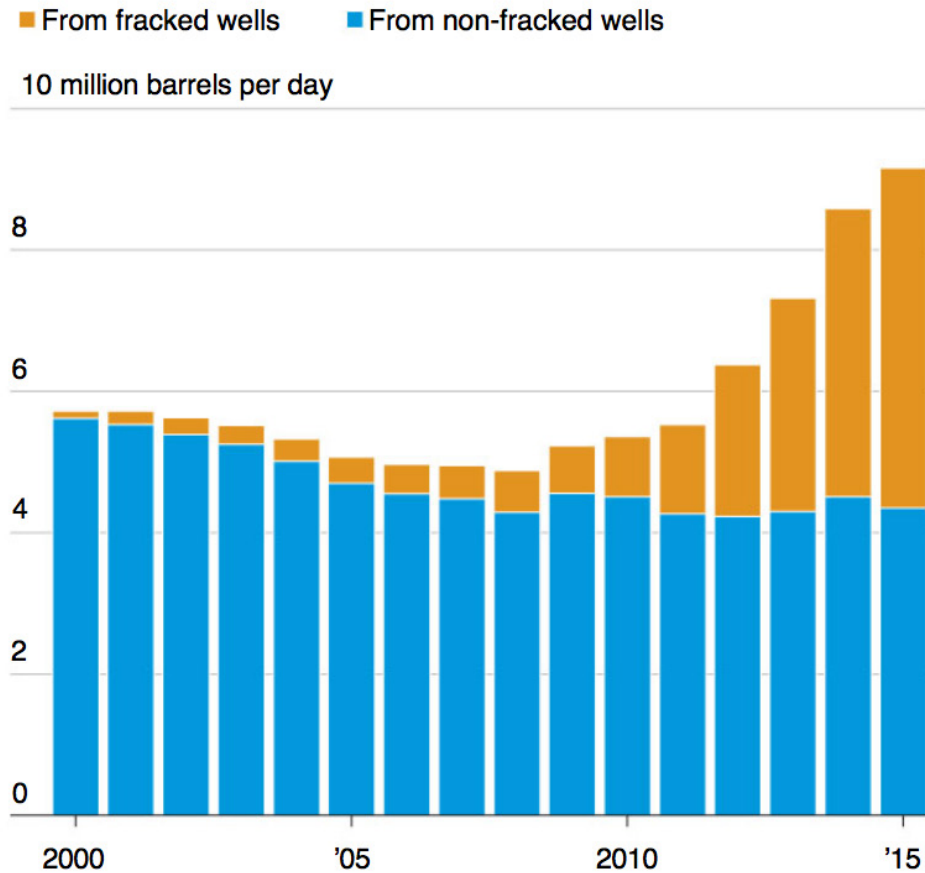
Source: Brookings Institution, "The Economic Benefits of Fracking." <https://www.brookings.edu/blog/brookings-now/2015/03/23/the-economic-benefits-of-fracking/>

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

Transformed Market

Fracking now accounts for about half of all U.S. oil production.



Source: U.S. Energy Information Administration

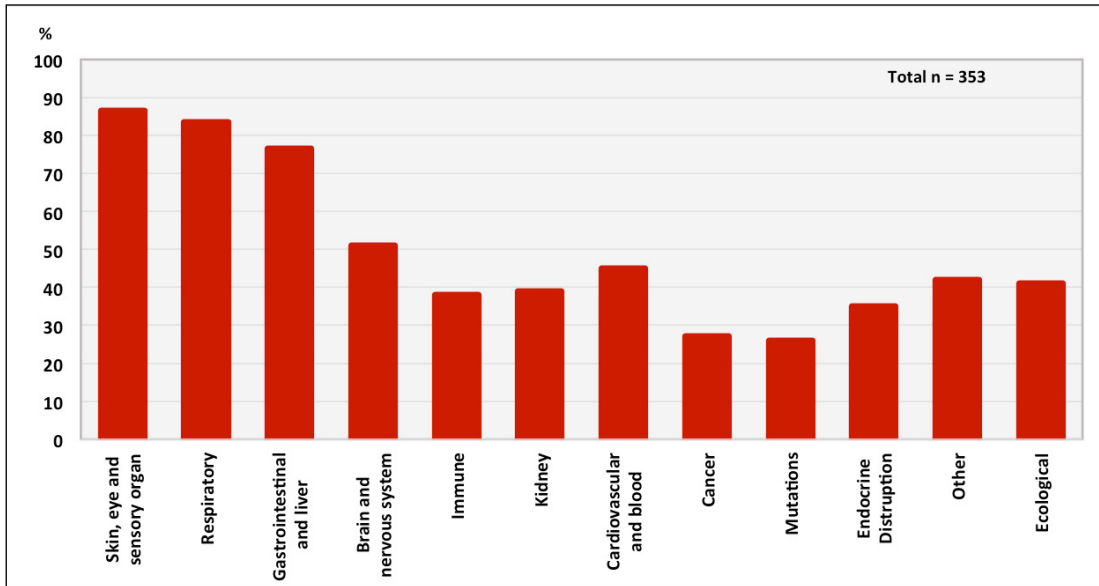
THE WALL STREET JOURNAL.

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)

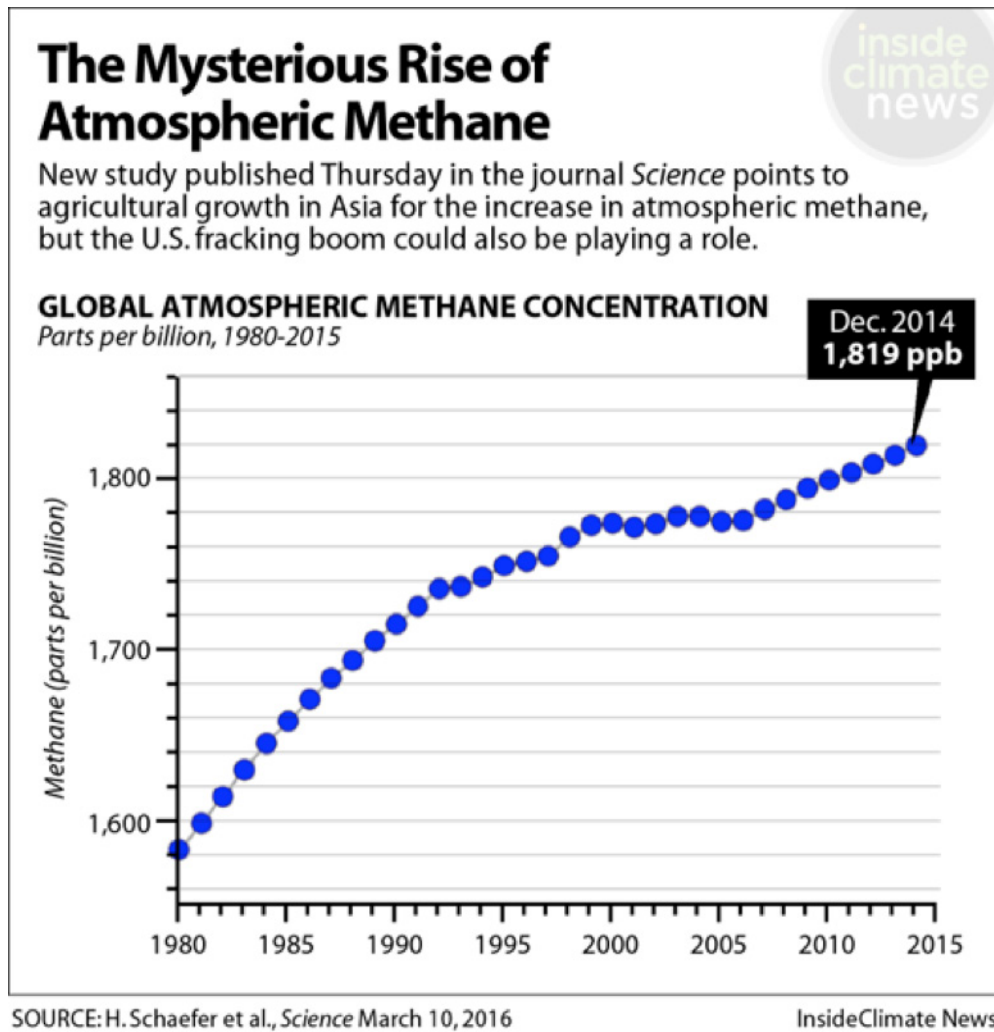


Human exposure to fracking chemicals can occur by ingesting chemicals that have spilled and entered drinking water sources, through direct skin contact with the chemicals or wastes (e.g., by workers, spill responders or health care professionals), or by breathing in vapors from flowback wastes stored 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://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.”

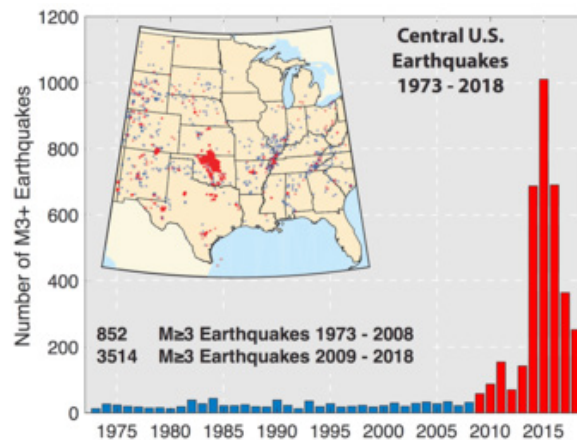
ARTIFACT #11: THE MYSTERIOUS RISE OF ATMOSPHERIC METHANE GRAPH



Source: InsideClimate News. <https://insideclimatenews.org/news/10032016/mysterious-global-methane-rise-asain-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, 1970-2016. 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/natural-hazards/earthquake-hazards/induced-earthquakes?qt-science_support_page_related_con=4#qt-science_support_page_related_con

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: _____



Your could argue that... _____

But here's the weakness in that argument:

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