Name \_\_\_\_\_ Day, Time \_\_\_\_\_\_

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# Watch Video: Animation of Hydraulic Fracturing (Fracking) [6:30]

<http://somup.com/cZVn0Gkrt5>

1. Summarize the process of Fracking using the following focus questions:

a. What resource is being mined (extracted from the ground) and for what purpose?

b. Give some strategies used to protect aquifers (ground water)?

c. Why is horizontal drilling advantageous?

d. What is fracking?

e. How long does it take? And how long can a well be sustained?

f. What are the benefits/positives of fracking?

g. What are the negatives/costs of fracking?

Fracking, or hydraulic fracturing, is a method of extracting natural gas and oil from shale rock formations deep within the earth. The process involves drilling a well and injecting a mixture of water, sand, and chemicals at high pressure into the rock to release the gas or oil. While fracking has been credited with creating jobs and boosting the economy, it has also been criticized for its potential environmental impact. Some of the concerns include water pollution, air pollution, and the release of methane gas, which is a potent greenhouse gas.

[According to a 2021 article in MIT Technology Review, the fracking boom in the United States has ended, and the industry has created fewer jobs than previously claimed](https://www.technologyreview.com/2021/07/01/1027822/fracking-boom-jobs-industry/). [Another article from TIME.com discusses Indonesia’s embrace of shale fracking and the potential costs associated with it](https://world.time.com/2013/06/25/indonesia-embraces-shale-fracking-but-at-what-cost/). [A 2012 article from Time Magazine argues that good regulation is needed to ensure the growth of the shale gas industry](https://science.time.com/2012/05/30/why-the-shale-gas-industry-needs-regulations-for-fracking/). [Finally, a 2012 article from Time Magazine suggests that the problems associated with fracking tend to be due to mistakes made in other parts of the drilling process](https://science.time.com/2012/02/17/shale-gas-its-not-the-fracking-that-might-be-the-problem-its-everything-else/).

*Summarize 2-3 main/key points for each video. State whether the video is supporting fracking or opposing fracking.*

<http://somup.com/cZVn0Lkruh> “Fracking for Natural Gas Continues to Raise Health Concerns” (8:10) [6/15/2011] Summary:

Australia Fracking

<http://somup.com/cZVecckruY> (3:21)

**After Videos: Answer the following questions:**

1. Why are energy companies interested in Fracking at this time?

2. What is the energy gained from Fracking used for?

3. What is government regulation?

4. Why do some people want to regulate the process of fracking?

5. Why do energy companies not want it to be regulated?

'Fracking' Waste Disposal Tied to Ohio Earthquakes

The Washington Times (Washington, DC), January 4, 2012

The disposal of wastewater used in the booming practice known as “fracking” is responsible for a rash of recent earthquakes in Ohio, and critics have latched on to the seismic events as evidence that the popular natural gas extraction method is dangerous and should be banned.

Ohio has experienced at least 11 tremors since March, including a 4.0 temblor that shook Youngstown on New Year’s Eve. State officials say the earthquakes were triggered by deep injection wells, where the water, sand and chemical cocktails used to frack wells are deposited.

State officials have shut down all disposal wells within a five-mile radius around the epicenter of the Dec. 31 tremor, which reportedly was felt as far away as upstate New York.

The events have cast more doubt on the safety of fracking, which has enabled companies to tap natural gas trapped thousands of feet below ground and, in the process, helped fuel economic revivals in Pennsylvania, North Dakota and elsewhere.

Last month, the Environmental Protection Agency blamed the process for the contamination of drinking water in the small town of Pavillion, Wyo. The industry has denied those charges, and a third-party review of the EPA report is expected to begin soon.

Further investigation of the Ohio earthquakes is also under way, and fracking supporters are sticking to their guns.

“There’s plenty of data out there that suggests this is not a recurring problem,” said Rob Nichols, spokesman for Ohio Gov. John Kasich, a Republican. “Natural gas could generate tens of thousands, if not hundreds of thousands, of jobs in Ohio. For those out there who are willing to drive a stake through the heart of what could be an economic boon, we’re not going to let that happen.”

Mr. Nichols stressed that fracking itself - as distinct from the waste disposal - is in no way responsible for the tremors, despite several news reports to the contrary. Federal officials have confirmed that the practice is unlikely to generate significant seismic activity.

“The fracking itself probably does not put enough energy into the ground to trigger an earthquake. … That’s really not something that we should be concerned about,” William Leith, senior science adviser for earthquake and geologic hazards with the U.S. Geological Survey, said in an interview with National Public Radio last month.

While the most recent temblor gave residents in and around Youngstown a scare, there were no serious injuries or property damage. With the exception of the New Year’s Eve event, all of the Ohio tremors had a magnitude of 2.7 or lower, barely blips on the radar screen when compared with the 5.8 earthquake that shook the East Coast last year.

That August quake - which also caused no deaths - was more than 1,000 times as powerful as a 2.7 temblor and still less than one-tenth as powerful as the 7.0 earthquakes that often cause catastrophic damage in such places as Japan, New Zealand and California.

Despite their relatively low magnitudes, Mr. Nichols said, the temblors are getting the necessary attention from state officials. All options, he said, will remain on the table, including a prohibition on wastewater wells near fault lines.

Fracking advocates also point out that while the disposals did cause the quakes, most natural gas companies do not dispose of fracking waste that way. Instead, they recycle and reuse the millions of gallons of water needed to frack a well.

Others opt for the much cheaper method of pumping the used fluids back into the ground. There are at least 177 such sites across Ohio, and about 1 million gallons of wastewater were deposited there last year.

The vast majority of those wells have caused no trouble, but Mr. Nichols and others expect the Ohio earthquakes to be used as ammunition for those fundamentally opposed to fracking for unrelated reasons, including hostility to fossil fuels.

“There are some out there who want nothing other than windmills and solar panels. But Ohio can’t meet its energy needs through those alone,” Mr. Nichols said.

**Summarize 5 main points**

The Fracas about Fracking - Low risk, high reward - but the EPA is against it. Kathleen Hartnett White June, 2011

A major boom in domestic oil and gas production is under way, brought about by breakthrough refinements of a 1940s technology known as hydraulic fracturing, or "fracking."

Hydraulic fracturing involves pumping water, sand, and some trace chemicals under high pressure into a completed wellbore to create fissures in relatively impermeable geologic formations such as shale. The fissures allow oil or natural gas to flow into the well. The sand props the fissures open, preventing the resealing of pathways. Combined with horizontal drilling at depths of one to more than two miles below the earth's surface, hydraulic fracturing has unlocked vast stores of natural gas.

Fracking is also now widely used in vertical and horizontal drilling in oil reservoirs with low permeability. Conventional oil reservoirs with permeable geologic formations allow oil to flow to the wellbore as a result of natural pressure. But in many wells, as much as 75 percent of the oil and gas may be left in place. Fracking is one of several new ways to get at the ample resources remaining after natural pressure subsides.

In these ways, human ingenuity, catalyzed by market dynamics, has foiled predictions of irreversible decline in domestic oil and natural-gas resources. Official estimates of the amount of recoverable oil and natural gas have soared. Last year, global natural-gas supplies rose 40 percent. From 2010 to 2011, the U.S. Energy Information Administration (EIA) doubled its estimate of recoverable natural gas in the U.S. The EIA increased its estimate of Texas's natural-gas reserves by 70 percent between 2005 and 2008, and Texas also is doing prolific fracking in oil: Producers now have access to 2 billion barrels in the Wolfberry formation in the Permian Basin. The Eagle Ford fields in South Texas increased oil production fourfold in the first ten months of 2010. And the Haynesville-Bossier fields, straddling Texas's border with Louisiana, increased reserves of natural gas by 9.4 trillion cubic feet while increasing production twelvefold.

The EIA also believes that natural gas in the Marcellus formation of New York, Pennsylvania, and West Virginia contains more BTUs of energy than do the oil reserves of Saudi Arabia. Drilling is well under way in Pennsylvania, where 141,000 new jobs in the "gas patch" have been created in the last few years. New York has declined to accept its energy wealth and instead imposed a de facto moratorium on fracking, pending the completion of an environmental-impact statement -- thus deferring the creation of hundreds of thousands of high-paying jobs.

Enormous new oil production is opening up in the Bakken fields of the Williston Basin, covering the Dakotas and Montana. In 2008, the U.S. Geological Survey estimated that the Bakken contained up to 4 billion barrels of technically recoverable oil. Current estimates range as high as 24 billion barrels.

Oil production made possible by fracking is not now as prodigious as that of natural gas, but this could change, especially if the federal government allows oil-shale development in the Rocky Mountain West, where 70 percent of recoverable oil shale lies beneath federal land. Most of the currently surging oil and gas production is on private land, where federal permission is not required and state governments are supportive.

A rapid increase of domestic supplies of oil and gas at a time of painful gas prices; high-paying new jobs; expansion of thousands of businesses; increased federal, state, and local tax revenues: What's not to like? And the lion's share of the fracking boom has been in natural gas -- the so-called bridge fuel to the green-energy economy that President Obama promotes at every turn.

A fierce anti-fracking movement is nonetheless growing. According to its most zealous critics, fracking may even kill you. They claim that the technology may transform the water from your faucet into fire, make your house explode, cause earthquakes, or poison you with toxic chemicals. Just watch the Oscar-nominated documentary film Gasland, shown on HBO and sure to join the canon of sensationalist environmental documentaries of which Al Gore's An Inconvenient Truth is the classic.

Gasland is packed with major errors, half-truths, distortions, and exaggerations. The narrator explains that the fracking process "blasts a mixture of water and chemicals 8,000 feet into the ground. The fracking is like a mini-earthquake . . . [with] a mix of over 596 chemicals." This is a serious mischaracterization. The hydraulic fracturing, in fact, creates small fissures with an average thickness of 1 millimeter -- as a result not of blasts, but of carefully engineered electric pulses.

As mentioned above, the fracking material is a mix of water, trace chemicals, and sand. Of the fracking fluid, over 99.5 percent is water and sand. Perhaps 0.5 percent is a mix, not of "596 chemicals" but of just a few, such as guar gum, an emulsifier commonly used in ice cream. And remember: These chemicals are diluted in millions of gallons of water.

The list of environmental perils attributed to hydraulic fracturing is long: contamination of drinking water, wastewater pollution of rivers, groundwater depletion, air emissions of toxic pollutants and greenhouse gases, radiation, and even earthquakes. But, with the exception of groundwater depletion, no causal connection between hydraulic fracturing itself and any of these environmental problems has been demonstrated. Faulty well construction, breaches in cemented and heavy-steel-encased wellbores, and accidents could, of course, lead to adverse environmental impacts. But there is no evidence that fracking itself is inherently damaging.

Highly audible critics of fracking have attributed all of the environmental risks noted above to natural-gas production in the Barnett shale area around Dallas-Fort Worth, now the most productive fracking effort in the country. Al Armendariz, the regional administrator of the EPA -- an Obama appointee and an environmental activist -- has amplified public alarm through his heavy-handed actions against a natural-gas company called Range Resources. Steven Lipsky, a Dallas landowner, complained of natural-gas (methane) contamination of his water wells to state authorities (who have primary regulatory jurisdiction on the matter) and to the nearby regional office of the EPA. State officials already were investigating, but the regional EPA opted to issue a rarely used emergency order of "imminent endangerment" against Range Resources, whose fracking wellbore was 4,000 feet below Lipsky's wells. Most well water comes from groundwater no more than 1,000 feet below the surface. Migration of contaminants from an oil or gas well often over a mile deeper is practically impossible. The Society of Petroleum Engineers estimates that over the last 60 years, more than 1 million oil and gas wells in the U.S. have used hydraulic fracturing. During this time, it has never been connected to groundwater contamination.

At a televised press conference, Armendariz claimed he had to act fast because two houses could explode at any moment. In fact, Lipsky and the owner of the other house had disconnected their drinking-water well from their houses, eliminating any potential that methane in the water might, under pressure in the water pipes, cause explosions in the houses.

Extensive testing proved that the natural gas produced by Range Resources had a different chemical signature than that of the natural gas in Lipsky's wells, which came from a shallow formation immediately below them. Local water-well drillers and residents testified that there always had been noticeable natural gas in the wells. Texas authorities have fully exonerated Range Resources -- but the EPA hasn't. The company is challenging the EPA's action in federal court but remains subject to fines of $16,500 per day.

Worries about some other dangers are equally unfounded. Air emissions from drilling sites have been the most persistent public concern in the Barnett shale area. Studies by the Texas Department of Health and the Texas Commission on Environmental Quality have confirmed that the emissions do not exceed levels protective of human health, but this conclusion has not allayed public fears because one of the pollutants involved is benzene -- a widely known carcinogen at certain levels and exposures. In fact, the monitored benzene levels attributed to natural-gas drilling in the Barnett shale are not harmful to human health, but, pressured by state legislators, the usually pragmatic state environmental regulators adopted a 1,000-page rule imposing onerous controls on the drilling sites that would be more appropriate for a large refinery.

The one credible concern is the extremely high volume of water used in the fracking process. Quantities vary, but 2 million gallons per day appears to be an average use. Drawdown of aquifers used for drinking water occurred in the Haynesville shale area in Louisiana, but the problem was resolved by shifting to water sources not used for drinking. Methods are now under development to reduce freshwater use by recycling wastewater after treatment.

The practice of fracking has also been put at risk by recent academic studies. Headlines claim that Duke University researchers "prove[d]" that hydraulic fracturing in Pennsylvania has contaminated domestic water wells with high levels of methane. Even the relatively cautious Wall Street Journal reported on May 10 that the study shows that fracking "appears to be allowing potentially explosive methane gas to seep into drinking-water wells." Closer review shows that the study did not reach this conclusion at all. It found a correlation between proximity to drilling activity and higher levels of methane in water wells, but did not attribute this to subsurface migration of natural gas from hydraulic fractures.

The study's primary author, Rob Jackson, concluded that the methane in the water wells tested in the study was far more likely to have come from faulty construction of the natural-gas well than from hydraulic fracturing. A major weakness in the study was its lack of baseline data. What was the level of methane in the wells before hydraulic fracturing? The authors also acknowledged that methane is naturally present in almost every private well used for drinking water, livestock water, and irrigation in the region. Geologists point out that comparatively higher levels of methane are usually found in the soil and groundwater of areas with oil and natural-gas resources.

In deciding on a policy on fracking, we should not wait for a congressionally mandated EPA report on the impacts of hydraulic fracturing on drinking water, due in 2012. A congressional hearing held in May revealed fatal flaws in what was supposed to be a definitive, vigorously peer-reviewed study. For one thing, it will be an inside job from the EPA; the study's review panel excludes anyone with professional expertise in current industry practices or the technology of hydraulic fracturing. Under the current administration, industry experts, like highly credentialed professors of petroleum engineering, are assumed to be shills for greedy enterprises.

The EPA study has some other serious defects. It will cherry-pick only four wells, out of hundreds of thousands, for full forensic analysis, and it has excluded representatives of state regulatory agencies -- which have six decades of experience in regulating this practice, which began in 1948 -- from its review panel. Nor do the researchers seem aware of the difference between, on one hand, models of the assumed effects of hydraulic fracturing and, on the other, physical measurements of the results of hundreds of actual fracking treatments. To learn the fundamentals of this issue, the EPA would have to bother to speak with experts on the technology.

The study seems designed to substantiate a predetermined conclusion: that hydraulic fracturing poses grave risks. Therefore, the EPA must either assert regulatory control on all drilling using this technology, or issue a "temporary" moratorium -- as in the aftermath of the 2010 Gulf spill -- until further study is complete. If fracking is delayed or discontinued, massive resources will remain untapped, hundreds of thousands of jobs will not be created, and billions of dollars of potential federal, state, and local tax revenues will be lost.

Risk can be managed and reduced, but never eliminated. Over the last 30 years, the on-shore oil and gas industry has had a sound environmental record. The many risks -- more uncertainties than palpable dangers -- attributed to hydraulic fracturing have not occasioned serious environmental harms. But, in only a few years, fracking has allowed recovery of approximately 7 billion barrels of oil and 7 trillion cubic feet of natural gas. Vast stores remain, and almost all new wells will need hydraulic fracturing.

The U.S. has far more energy resources than any other country, yet no other country so limits and blocks access to its own energy supply. The opposition to fracking displays this unfortunate mentality.

*Kathleen Hartnett White is director of the Armstrong Center for Energy & the Environment at the Texas Public Policy Foundation. She previously served, for six years, as chairman of the Texas Commission on Environmental Quality, the second-largest environmental regulatory agency in the world.*

**Summarize 5 main points**

# ANSWERS

# Watch Video: Animation of Hydraulic Fracturing (fracking) [6:36]

<http://www.youtube.com/watch?v=VY34PQUiwOQ>

1. Summarize the process of Fracking using the following focus questions:

a. What resource is being mined (extracted from the ground) and for what purpose?

*Shale is mined to extract oil & natural gas.*

b. Give some strategies used to protect aquifers (ground water)?

*The digging goes well below the aquifers; Concrete surrounds steel pipe (surface casing). Sometimes additional casings are installed.*

c. Why is horizontal drilling advantageous?

*It is possible to drill several wells from one horizontal line (drilling pad), minimizing impact to the surface environment.*

d. What is fracking?

*Hydraulic fracturing 🡪 pumping a mixture of water and sand with some chemicals (lubrication, keep bacteria from forming, to carry sand) into deep reservoir formations. A perforation fluid creates fractures in rock. The sand keeps the rocks open, allowing oil or natural gas to flow to the well bore.*

e. How long does it take? And how long can a well be sustained?

*From 3 to 5 months: a few weeks to prepare the site; 4-6 weeks to drill the well; 1-3 months of completion activities.*

*A well can be sustained for 20-40 years.*

f. What are the benefits/positives of fracking?

*Fracking allows access to oil and natural gas in areas that were previously inaccessible.*

g. What are the negatives/costs of fracking?

*Ground water contamination by chemicals, oil, natural gas.*

*Summarize 2-3 main/key points for each video, showing the pros and cons of fracking. State whether the video is supporting fracking or opposing fracking.*

“The Fuss Over Fracking: The Dilemma of a New Gas Boom” (8:30) Summary:

* *The Burnett’s water had been contaminated by a spill from a gas well*
* *Water laced with chemicals from the drilling process leaked into their pond*
* *300-500 gallons of hydrochloric acid spilled, killing all fish (life) in the pond. They were told not to drink their well water.*
* *Other reports said that their sink faucets ignited into flames, that chemicals (strontium) poisoned livestock, traffic congestion including large tankers & trucks, unkept promises to remedy problems with fracking.*
* *Clearly AGAINST fracking*

<http://www.pbs.org/newshour/bb/science/jan-june11/fracking_06-15.html>

“Fracking for Natural Gas Continues to Raise Health Concerns” (8:20) Summary:

* *People can light their faucet water on fire due to methane gas. Gasland was a nationally publicized documentary that raised awareness and got the legislature involved.*
* *Fracking uses 90% water, 9% sand, 1 % chemicals. The chemicals have gotten the attention.*
* *The Bells had 3 spills on their property before selling. They claimed to continue to have coughs, headaches, and memory loss.*
* *The EPA has stepped in to do a 2 year investigation. A congresswoman claimed that 29/750 chemicals used in fracking fluid were carcinogenic.*
* *The fracking companies are now disclosing the chemicals used (wanted to protect their rights) and state that government officials do not have scientific data to back legislation.*
* *While companies claim no documented issues, the general public can ignite water on their land.*
* *Congresswoman Degette wants a national standard. Companies want state standards rather than national due to differences in land formation.*

“Flaming Faucets: When Fracking Goes Wrong” (5:00) Summary:

* *The family were promised $100/acre of farm land used, plus monthly royalties with a non-invasive process. Yet, the construction was within 500 feet of their home. They lost 9 acres of land and got contaminated water.*
* *Pennsylvania has the highest reservoirs of gas-rich shale in the country. Jobs, money, cheap energy resources.*
* *The dangers of fracking became close to home. 2 days after a maintenance, the faucets sputtered and the methane levels were so high she could ignite her water. A vent pipe was installed to allow methane gas to be released rather than explode underground.*
* *The Dept of Environmental Protection forced the fracking company to install the methane vent. They also discovered dangerous levels of radioactive barium and strontium.*
* *Clearly AGAINST fracking*

**After Videos: Answer the following questions in your groups:**

1. Why are energy companies interested in Fracking at this time?

*Fracking can create lots of jobs and money because natural gas is a much used and wanted resource.*

2. What is the energy gained from Fracking used for?

*Fracking mainly is used to create electricity and as a heat source (e.g. stoves, furnaces, water heater, etc.)*

3. What is government regulation?

*Government regulation is control of private and government (public) enterprise. They assess taxes and place restrictions, limits, and other controls on the use of commodities.*

4. Why do some people want to regulate the process of fracking?

*Fracking has some dangers attached to it like ground water contamination due to chemicals, water igniting into flames, natural gas venting into the atmosphere, construction sites taking up land, etc.*

5. Why do energy companies not want it to be regulated?

*Energy companies do not want regulation because it lowers their income since money must go to research and development, proper construction, safety measures, etc. They also realize that government officials do not necessarily understand the science behind their resources and products and may incur unnecessary restrictions.* 'Fracking' waste disposal tied to Ohio earthquakes

The Washington Times (Washington, DC) , January 4, 2012

<http://www.washingtontimes.com/news/2012/jan/3/fracking-waste-disposal-tied-to-ohio-earthquakes/?page=all>

**Summarize 5 main points**

* *The disposal of wastewater used in the booming practice known as “fracking” is responsible for a rash of recent earthquakes in Ohio*
* *the earthquakes were triggered by deep injection wells, where the water, sand and chemical cocktails used to frack wells are deposited*
* *Natural gas could generate tens of thousands, if not hundreds of thousands, of jobs in Ohio*
* *Fracking advocates also point out that while the disposals did cause the quakes, most natural gas companies do not dispose of fracking waste that way. Instead, they recycle and reuse the millions of gallons of water needed to frack a well.*
* *The vast majority of those wells have caused no trouble, but* [*Mr. Nichols*](http://www.washingtontimes.com/topics/rob-nichols/) *and others expect the Ohio earthquakes to be used as ammunition for those fundamentally opposed to fracking for unrelated reasons, including hostility to fossil fuels.*

## The Fracas about Fracking: low risk, high reward--but the EPA is against it

National Review, June 20, 2011

**Summarize 5 main points**

* *Hydraulic fracturing involves pumping water, sand, and some trace chemicals under high pressure into a completed wellbore to create fissures in relatively impermeable geologic formations such as shale. The fissures allow oil or natural gas to flow into the well. The sand props the fissures open, preventing the resealing of pathways. Combined with horizontal drilling at depths of one to more than two miles below the earth’s surface, hydraulic fracturing has unlocked vast stores of natural gas.*
* *Fracking is also now widely used in vertical and horizontal drilling in oil reservoirs with low permeability.*
* *Last year, global natural-gas supplies rose 40 percent. From 2010 to 2011, the U.S. Energy Information Administration (EIA) doubled its estimate of recoverable natural gas in the U.S.*
* *The EIA also believes that natural gas in the Marcellus formation of New York, Pennsylvania, and West Virginia contains more BTUs of energy than do the oil reserves of Saudi Arabia.*
* *Most of the currently surging oil and gas production is on private land, where federal permission is not required and state governments are supportive.*
* *A rapid increase of domestic supplies of oil and gas at a time of painful gas prices; high-paying new jobs; expansion of thousands of businesses; increased federal, state, and local tax revenues: What’s not to like?*
* *A fierce anti-fracking movement is nonetheless growing. According to its most zealous critics, fracking may even kill you. They claim that the technology may transform the water from your faucet into fire, make your house explode, cause earthquakes, or poison you with toxic chemicals.*

Natural gas flip-flop: big environmental groups were for fracking before they were against it

Reason, August-September 2011

**Summarize 5 main points**

* *THE WORLD's projected natural gas supplies jumped 40 percent last year. … The ability to produce clean-burning natural gas from shale could transform the global energy economy.*
* *The EIA estimates total U.S. natural gas reserves at 2,543 TCF, which suggests that the U.S. has enough natural gas to last about 70 years if it entirely replaced the current level of coal-powered electricity generation.*
* *Replacing dirtier coal and gasoline with natural gas would reduce overall U.S. carbon dioxide emissions by about 25 percent.*
* *Natural gas is cheaper than renewable sources of energy. Electricity produced using natural gas in a combined cycle generating plant comes in at $66 per megawatt-hour. By contrast, offshore wind clocks in at $243 per megawatt-hour, photovoltaic at $211, solar thermal at $312, geothermal at $102, and biomass at $113. The only renewable sources that are close to competitive with natural gas are onshore wind at $97 per megawatt-hour and hydroelectric at $86.*
* *What about radioactive contamination of streams by well wastewater? The Pennsylvania Department of Environmental Protection announced that after checking samples taken downstream from the wastewater plants that had treated gas well water, it found that "all samples were at or below background levels of radioactivity;*
* *As far as using too much fresh water is concerned, Ridley points out that gas drilling in Pennsylvania uses about 60 million gallons per day, which compares to 1,550 million gallons used by public water systems.*
* *A team of researchers led by the Cornell ecologist Robert Howarth suggested that the greenhouse gas emissions released by natural gas production are worse than those produced by burning coal. Natural gas is methane, which on a molecule per molecule basis has a much greater ability to trap heat from the sun than carbon dioxide does. Howarth claims that methane leaking from natural gas wells contributes so much to global warming that the benefits of substituting it for coal are overwhelmed.*

## Big Frack Attack: Is Hydraulic Fracturing Safe?

**Summarize 5 main points**

* *Some estimates put the country's recoverable shale gas reserves as high as 616 trillion cubic feet, enough to meet current demand for 27 years. And thanks to advances in drilling technology, namely fracking, armies of gas rigs have suddenly uncorked an ample new power source just as many of the planet's known fossil fuel reserves are fading. By 2011, the Department of Energy predicts 50 to 60 percent of all growth in known U.S. gas reserves will come from shale.*
* *Natural gas emits fewer greenhouse gases than other fossil fuels — about half as much carbon dioxide as coal, for example — and thus contributes less to global warming.*
* *Some critics say embracing natural gas so heartily will slow the rise of renewable energy, but the biggest beef with shale isn't as much about its gas — it's about how we get it out of the ground. Shale gas would likely still be a novelty fuel without modern advances in hydraulic fracturing, yet the need for fracking is also starting to seem like shale's fatal flaw.*
* *The EPA is in the early stages of a two-year study to assess the practice's risks, and in November it subpoenaed energy giant Halliburton for information on specific fracking chemicals it uses. It also recently ordered a Texas gas company to stop all work after methane and benzene appeared in nearby drinking-water wells. Some states and cities are also taking notice — Pittsburgh banned fracking within city limits in November, for example, and the New York Legislature followed suit with a statewide ban passed this month.*
* *The best way to get more gas out is to drill in sideways; Drillers pump pressurized water, sand and chemicals down a newly drilled well, forcing them through perforations in its casing so they blast out to the surrounding shale, opening new cracks and widening old ones.*
* *Hydraulic fracturing is a bit like using a garden hose, Ingraffea says: "You're trying to pump large volumes of fluid at high pressure through something that's six inches wide and two miles long, so a lot of energy is lost."*
* *Blasting pressurized water so deeply into the Earth's crust has the potential to do more than just widen small cracks in the bedrock — if it hits the right underground fissure at the right angle and speed, it can actually trigger an earthquake.*