

# GDL sample assignment: Fracking for fuel

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## Preface

I want to provide samples of how to complete the GDL assignment. This document describes my research and outlining process as it happened. For general use, I also try to explain how I expect a student working on the GDL assignment to proceed.

Because I have thought about projects like this one for a long time, I keep folders of articles related to topics I care about. Several of the articles deal with nuclear disarmament, chemical weapons, rare earth metals, climate change, and various matters related to energy. To avoid direct imitation of my work, the examples below draw from a topic relevant to CH-127-GDL (Introduction to General Chemistry) instead of CH-128.

I chose to write about “fracking”, a process to find hydrocarbon fuel. Please see my public journal on Blackboard for a version of this narrative broken into several posts.

## Choosing a general-interest article Assignment 1

Just a short piece in the New York Times explicitly mentions such groups as energy companies, policy-makers, and investors (Barringer 2013). It reports that some people living near fracking sites must compete for water resources, because fracking typically uses large amounts of otherwise drinkable water. The article also suggests that pollution from fracking sites may directly affect people living nearby.

Barringer, Felicity. “Spread of Hydrofracking Could Strain Water Resources in the West, Study Finds.” *New York Times* (2 May 2013): A12.

## Choosing two more articles Assignment 2

My folder of CH-127-related articles also contained a long piece from *Fortune* magazine (Otterbourg 2014). This article would have been a perfect business-oriented source, but I thought it would seem like cheating to have all my sources chosen ahead of time. I cite the *Fortune* article below, but I did not use it and instead found two additional new articles in accordance with Assignment 2.

Otterbourg, Ken. “The Energy Boom’s Mighty Middleman.” *Fortune* (16 June 2014): 222–230.

### Science-oriented press

Searching for “fracking” at <http://cen.acs.org/index.html> led to a great background article (Ritter 2014) that also discussed how the technology may evolve in the future. This article was perfect, but because I disqualified the *Fortune* article, I still needed one more.

Ritter, Stephen K. “A New Way of Fracking.” *Chemical & Engineering News* 92 (12 May 2014): 31–33.

### Side-tracked by political sources (BONUS Assignment 3)

To find something more opinionated, I first searched *The American Conservative*<sup>1</sup> and *The Nation*<sup>2</sup>, both of which led to the same surprisingly critical article (Gilbert 2014) in the *Wall Street Journal*. I saved this article although I already had a general-interest source.

I next used the search-site <https://ixquick.com> to search another political magazine, <http://nationalreview.com><sup>3</sup>. A blog post (Zubrin 2014) and dead-tree article (Williamson 2012) appeared. The piece by Zubrin raised the idea that the Russian government depends on money raised by oil exports, so fracking abroad weakened Russian influence in Europe and elsewhere. This point was interesting, but I did not think a blog-post was appropriate to cite.

The article by Williamson was longer and—though politically biased—a strident defense of fracking. I counted this article as the extra-credit (Assignment 3) source and then moved on to find a third source for Assignment 2.

Williamson, Kevin D. “The Truth about Fracking.” *National Review* (20 February 2012).

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<sup>1</sup><http://theamericanconservative.com>

<sup>2</sup><http://thenation.com>

<sup>3</sup>At <http://google.com> or <https://ixquick.com>, you can enter your search terms with “site:nationalreview.com” (for example), and the engine will only search that web domain.

## Back to the business-oriented press

My next searches were a little confused. I mis-remembered two relatively obscure magazines, *The American Interest*<sup>4</sup> and *The National Interest*<sup>5</sup>, as other (biased) political websites. Bias itself is not a problem, but I needed a different source, since my article from Williamson, above, covered that category of publication.

Both *The American Interest* and *The National Interest* are, in fact, largely neutral policy-oriented magazines, with content from many political perspectives. A search at the website of *The American Interest* led to many interesting posts, such as <http://www.the-american-interest.com/2014/09/28/how-american-fracking-could-cause-a-russian-recession/>, which cited a Bloomberg article (Tartar and Andrianova 2014) that reported on the relationship of fracking in America to public finance in Russia without as much opinion as in *National Review*. I printed Tartar and Andrianova's piece and finished the required bibliography—and I accidentally found some extra sources at the same time.

Tartar, Andre and Anna Andrianova. "Russia Risks Recession as Oil Drop Seen Squeezing Budget." *Bloomberg* (26 September 2014).

## Works Cited

- Barringer, Felicity. "Spread of Hydrofracking Could Strain Water Resources in the West, Study Finds." *New York Times* (2 May 2013): A12.
- Gilbert, Daniel. "Exxon Chief Joins Lawsuit Raising Ruckus Over Fracking." *Wall Street Journal* (21 February 2014).
- Otterbourg, Ken. "The Energy Boom's Mighty Middleman." *Fortune* (16 June 2014): 222–230.
- Ritter, Stephen K. "A New Way of Fracking." *Chemical & Engineering News* 92 (12 May 2014): 31–33.
- Tartar, Andre and Anna Andrianova. "Russia Risks Recession as Oil Drop Seen Squeezing Budget." *Bloomberg* (26 September 2014).
- Williamson, Kevin D. "The Truth about Fracking." *National Review* (20 February 2012).
- Zubrin, Robert. "Putin's Anti-Fracking Campaign." *National Review Online* (5 May 2014).

The citations above include all articles I consulted, even if I did not plan to cite them. Now I had to read them.

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<sup>4</sup><http://the-american-interest.com>

<sup>5</sup><http://nationalinterest.org>

## Active reading (*a.k.a.*, a pre-outline) Assignment 4, part I

I have a ritual for marking-up articles and books as I read them. The basics of my process follow below:

- Identify (underline) **main ideas and facts** that explain the problem or give the issue context
- Identify groups of people—**communities**—affected by the issue. Think about whether the issue presents a problem or an opportunity for each community. **Not every group is affected the same way**, even for the rare issues with truly global consequences.
- Identify any connections to chemistry—chemicals, reactions, *etc.*.
- Include your own reactions, even if only in a word or scribble: ! for surprise, ? for confusion, X for disagreement, *etc.*
- Note any other interesting quotes or tidbits; they may be useful later.

A more involved paper may require that you follow up on any references within each source.

### Outlines help

Typically one would jot these notes in the margins of each article next to underlined passages. I have typed them primarily for your convenience, and to reveal my writing process.

By typing all the notes, I did save myself a lot of time arranging the outline for Assignment 4. I show below that **the outline is not simply a skeleton of how the paper will look**—Assignment 4 describes the skeleton of the paper. Rather, **the outline arranges content from your research** according to that skeleton.

By organizing my material below in a few steps, I moved steadily from

1. simply cataloguing my notes, to
2. identifying the background material appropriate for the Introduction (and Body), to
3. finding ideas from one source that related to ideas in another, to
4. developing my own judgments about various aspects of the issue.

After the outline there is still some work to be done, such as paraphrasing long passages and linking various ideas into cogent paragraphs. My main message is that writing the outline for the first time ought to be more work than writing the rough draft from the outline.

## General-interest source: NYT

### Facts about the issue

- Water is already scarce in western Colorado (Barringer 2013)
- Extracting oil and gas by “fracking” uses large amounts of water (Barringer 2013)
- “. . . competition and conflicts over water should be a growing concern for companies, policy makers, and investors.” –Report by Ceres (Barringer 2013)
- In south Texas, “as much as one-third of the areas annual groundwater recharge” may be used in fracking (Barringer 2013)
- Engineers at University of Texas, Austin, found that Near Fort Worth, TX, almost 2.9 billion gallons of water were used for fracking in 2011 (Barringer 2013)
- Recycling used water may reduce the conflict (Barringer 2013)
- Recycling may be expensive (Barringer 2013)
- Using “brackish, undrinkable water in place of fresh water” may reduce the conflict (Barringer 2013)
- “[Water] is a private commodity that people can do with what they want. We’re not going to go thirsty. We’re just going to have to pay more.” –Kenneth H. Carlson, engineering professor at Colorado State University (Barringer 2013)

### Communities affected

- Energy companies (Barringer 2013)
- Policy-makers (Barringer 2013)
- Investors (Barringer 2013)
- Residents affected by water scarcity (Barringer 2013)
- Residents affected by pollution (Barringer 2013)
- Consumers of energy (Barringer 2013)

### Connection to chemistry

- Water used in fracking contains “a proprietary mixture of chemicals and sand” (Barringer 2013)
- “[t]he water returning from thousands of feet below the surface can also contain natural pollutants or even radioactivity.” (Barringer 2013)
- brackish (definition) — slightly salty

## Science-oriented source: C&ENews

### Facts about the issue

- Fracking is also known as “hydraulic fracturing”
- “[h]igh pressure generated by the pumped fluid is used to fracture the rock” to liberate oil and gas from shale deposits (Ritter 2014)
- “So far fracking has yielded more than 7 billion barrels of oil and 600 trillion cu ft of natural gas in the U.S. alone, according to the American Petroleum Institute.” (Ritter 2014)
- Fracking requires a large amount of fresh water (Ritter 2014)
- Fracking generates waste (Ritter 2014)
- Fracking contaminates drinking water near drilling sites (Ritter 2014)
- Hydrocarbons continue to seep from wells for 20–40 years (Ritter 2014)
- Each well is fracked up to 20 times. Each round of fracking consumes millions of gallons of water per well (Ritter 2014).
- “[F]racking fluid should remain trapped deep below ground or should come back out of the well hole where it can be captured, reused, or disposed of as waste.” (Ritter 2014)
- “Hypothetically speaking, most of the pollution risk from tracking stems from how operators handle the fracking fluid and the waste flowback fluid aboveground . . . [but] accidents happen.” (Ritter 2014)
- “Improved tracers to monitor wayward tracking fluid could provide a level of transparency to allay public concerns.” (Ritter 2014)
- “[T]oday’s oil and gas is trapped in rock that is less permeable than concrete, which is why we need fracking,” according to Andrew R. Barron of Rice University and the company FracEnsure.

### Communities affected

- Developers of new fracking technology (Ritter 2014)
- Developers of tracers and other technology to test the safety of fracking (Ritter 2014)
- “Residents in some areas where fracking is taking place have encountered methane in their water and worry about what else might be in it.” (Ritter 2014)

### Connection to chemistry

- New methods may reduce the environmental impact of fracking (Ritter 2014)
- The fluid used in fracking contains (Ritter 2014)
  - 90% water
  - 10% sand or ceramic material
  - <1% chemical additives, such as
    - \* hydrochloric acid to clear debris
    - \* guar gum to increase viscosity
    - \* polyacrylamide plastic to improve flow
    - \* ethylene glycol to prevent deposits
    - \* methanol to protect steel equipment
    - \* glutaraldehyde to kill microbes; this component is most dangerous to the environment
- The company GasFrac uses liquid propane gel with 1% ferric sulfate and magnesium oxide instead of water
  - GasFrac’s process uses one-tenth the fluid
  - “Because propane is a hydrocarbon, it simply becomes part of the oil or gas production stream, whereas water tends to get stuck in the formation.” –James Hill of GasFrac (Ritter 2014)
  - Groundwater must still be treated
  - No need for a biocide like glutaraldehyde
  - GasFrac’s process has used “500 million gallons of propane and 100 million lb of proppant . . . [but] accounts for less than 1% of the North American fracturing market.” (Ritter 2014)
- Several companies are developing technology to verify that fracking wells are properly constructed and do not contaminate the area with fracking fluid (Ritter 2014).
  - “Fracking operators often track short-lived radioactive isotope tracers such as  $^{110}\text{Ag}$  or  $^{131}\text{I}$  . . .” (Ritter 2014)
  - FracEnsure “is developing superparamagnetic metal oxide nanoparticle tracers.” (Ritter 2014)
  - Andrew R. Barron of FracEnsure and Rice University believes nanoparticles could help monitor whether injection wells to store industrial wastewater such as fracking fluid remain sealed (Ritter 2014)
  - Oxane Materials supplies ceramic proppant (Ritter 2014)
  - BaseTrace uses artificial DNA to trace fracking fluid (Ritter 2014)

## **Business-oriented source: Bloomberg**

### **Facts about the issue**

- Russia is “the world’s biggest energy exporter” (Tartar and Andrianova 2014)
- “[T]he U.S. shale boom means oil production outside OPEC is rising by the most since the 1980s, according to the International Energy agency.” (Tartar and Andrianova 2014)
- Low oil prices may lead to an economic recession in Russia (Tartar and Andrianova 2014)
- “The decline in oil prices . . . [is] limiting Russian ability to withstand sanctions,” (Tartar and Andrianova 2014)
- “ . . . Russia’s fiscal position is becoming even more tightly linked to oil revenues and global oil price trends,” according to the World Bank (Tartar and Andrianova 2014)

### **Communities affected**

- Russian public
- Russian government

## **Additional general-interest source: Wall Street Journal**

Note: I learned about this article by searching two different political publications, as mentioned above. The assignment did not require a second general-interest source, but I found this short article interesting.

You are always free to use additional sources.

### **Facts about the issue**

- “Fracking, which requires heavy trucks to haul and pump massive amounts of water, unlocks oil and gas from dense rock and has helped touch off a surge in U.S. energy output.” (Gilbert 2014)
- According to a legal challenge filed by residents in Bartonville, TX, plans to build a tower to provide water for fracking would lead to “a noise nuisance and traffic hazard.” (Gilbert 2014)
- Building the tower may lower property values in the area (Gilbert 2014)
- Among those complaining about the tower are Rex Tillerson, CEO of Exxon, and former U.S. House Majority Leader Dick Armey (Gilbert 2014)
- Fracking is “a core part of Exxon’s business.” (Gilbert 2014)

### **Communities affected**

- Utility companies like Cross Timbers Water Supply Corp. that build water towers
- Small energy companies, like XTO Energy, Inc. that frack
- Large energy companies, like Exxon that buy smaller companies and also make money by fracking
- Residents and other users of water near fracking sites
- Property-owners near fracking sites

### **BONUS Political source: National Review**

Some sources are more straightforward about their editorial viewpoint than others. It is always important to be appropriately critical of your sources.

### **Facts about the issue**

- High estimates of the amount of recoverable gas in the Marcellus field approach 15 years of total energy use in the U.S. (Williamson 2012)
- Oil imports are about half of the U.S. trade deficit (N.B.: Not total trade) (Williamson 2012)
- Burning coal—which is very dirty—produces about half of U.S. electricity (Williamson 2012)
- Fracking for natural gas has produced “[t]ens of thousands of new jobs” (Williamson 2012)
- Fracking prompts capital investments near sites: buildings, roads, machinery, *etc.*
- Gas-rich shale formations are very far from the aquifer (underground water table), so ground water ought to be unaffected by fracking (Williamson 2012)
- Fracking is very loud (Williamson 2012)
- “We are well and appropriately regulated by the state.” (Williamson 2012) —engineer Mark Whitley of Range Resources, working in Pennsylvania
- Water must be clean enough to drink to be discharged in Pennsylvania, so treated water is valuable enough to sell (Williamson 2012)

### Connection to chemistry

- Williamson claims that biocides are “not very different from what’s in your swimming pool,” (Williamson 2012) which is true in that both kill microbes, but chlorine bleach and glutaraldehyde are actually very different chemicals.
- “Gas drillers but their bits down through a lot of ancient seabeds, meaning that the water com up saturated with our tasty friend NaCl, a.k.a. salt.” (Williamson 2012)
- Waste water also contains potassium salts, arsenic, radioactive material, and reactive bromides (Williamson 2012)
- According to John Hanger, Pennsylvania’s former secretary at the Department of Environmental Protection, “If there’s no fracking, the unavoidable consequence would be a sharp increase in oil and coal consumption. Even if environmental and public-health issues were your only concerns—leave aside national security and economic impacts—that fact alone should give you pause.” (Williamson 2012)

### Communities affected

- People employed directly or indirectly through increased fracking
  - White-collar engineers
  - Blue-collar truckers and other laborers
  - Supporting workers, such as restaurant owners and employees
- People near fracking sites who experience noise pollution
- Communities in places like West Virginia, where wastewater can be dumped directly into rivers or onto the ground (Williamson 2012)
- Environmental activists (Williamson says that left-leaning environmentalists are “led by Occupy Wall Street,” (Williamson 2012) which I doubt)
- Regulators at the state level, who currently do most of the regulating
- Regulators at the national level, who may become involved later if states fail to manage environmental risks

## Organizing the outline

### Assignment 4, part II

Finding the first article only required a few minutes. Even with the extra research I did to replace disqualified articles, I do not think the rest of my research took more than another hour or two over coffee.

Reading and underlining the articles probably only took another hour, although I did spend another hour or two paraphrasing and typing the passages cited, above. So far I have spent a bit more time than I expect of most students, but it is at this stage that my extra work typing the notes pays off: I already have about six pages of material for a three-to-five page paper, and cutting-and-pasting from the above yields a decent outline.

## The structure of the outline

Assignment 4 strongly suggested the following format for your outline:

**Title:** An informative title (not, for example, “Chem Paper Outline”)

**Introduction:** What topic did you choose? Why is your topic important? How does it relate to global concerns, such as sustainability? Briefly, how does your topic affect different communities and how is it relevant to material discussed in CH-128?

**Body, Connection to the course:** Expand on how your topic relates to material covered in CH-128. The connections may be broad or mostly related to material we have not yet discussed, but you must convince the reader that your topic is appropriate for the assignment.<sup>6</sup>

**Body, Diverse viewpoints:** For each of at least **three communities** affected by the global issue—

- Identify and define the community. Where are its members located? What are its most important characteristics? It is a geographical group, an ethnic group, a group defined by some economic or health-related status, *etc.*?
- Describe how the group is affected by the issue. Include quotations, if applicable. What challenges or opportunities does the issue present?
- Identify and describe the communities’ consensus view (or views, if opinion is evenly split) toward the issue. What response would the community advocate? You may imagine various scenarios and responses, such as at local and national or global levels.

**Body, Discussion:** Analyze and criticize each consensus view. Is it reasonable for a particular community to hold its view? Why, and according to what evidence? Do any communities appear in conflict with the balance of evidence? Do any communities appear in conflict with *each other*? Do any communities advocate a response that is unreasonable, impossible, or otherwise ill-advised? Explain.

**Conclusion:** Propose a response to the global issue. You may largely agree with one or more communities identified above, but you must defend your position. Why advocate such a response? What communities might object? How would you answer their objections?

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<sup>6</sup>If it is not clear to you how your topic relates to the course, you may wish to consider a different topic.

**Bibliography:** In MLA format.

## Starting the outline

The Discussion and Conclusion require commenting on what comes before. I only outline the first four of six components for now.

**Title:** New fracking practices may keep energy prices low with manageable impact to the environment and surrounding community

### Introduction:

- Fracking is also known as “hydraulic fracturing”
- “Fracking, which requires heavy trucks to haul and pump massive amounts of water, unlocks oil and gas from dense rock and has helped touch off a surge in U.S. energy output.” (Gilbert 2014)
- “[h]igh pressure generated by the pumped fluid is used to fracture the rock” to liberate oil and gas from shale deposits (Ritter 2014)
- “So far fracking has yielded more than 7 billion barrels of oil and 600 trillion cu ft of natural gas in the U.S. alone, according to the American Petroleum Institute.” (Ritter 2014)
- High estimates of the amount of recoverable gas in the Marcellus field approach 15 years of total energy use in the U.S. (Williamson 2012)
- “[T]he U.S. shale boom means oil production outside OPEC is rising by the most since the 1980s, according to the International Energy agency.” (Tartar and Andrianova 2014)
- “The decline in oil prices . . . [is] limiting Russian ability to withstand sanctions,” (Tartar and Andrianova 2014)

### Connection to the course:

- The fluid used in fracking contains (Ritter 2014)
  - 90% water
  - 10% sand or ceramic material
  - <1% chemical additives, such as
    - \* hydrochloric acid to clear debris
    - \* guar gum to increase viscosity
    - \* polyacrylamide plastic to improve flow
    - \* ethylene glycol to prevent deposits
    - \* methanol to protect steel equipment

\* glutaraldehyde to kill microbes; this component is most dangerous to the environment

- “Gas drillers put their bits down through a lot of ancient seabeds, meaning that the water com up saturated with our tasty friend NaCl, a.k.a. salt.” (Williamson 2012)
- Waste water also contains potassium salts, arsenic, radioactive material, and reactive bromides (Williamson 2012)
- New methods may reduce the environmental impact of fracking (Ritter 2014)
- The company GasFrac uses liquid propane gel with 1% ferric sulfate and magnesium oxide instead of water
  - GasFrac’s process uses one-tenth the fluid
  - “Because propane is a hydrocarbon, it simply becomes part of the oil or gas production stream, whereas water tends to get stuck in the formation.” –James Hill of GasFrac (Ritter 2014)
  - Groundwater must still be treated
  - No need for a biocide like glutaraldehyde
  - GasFrac’s process has used “500 million gallons of propane and 100 million lb of proppant . . . [but] accounts for less than 1% of the North American fracturing market.” (Ritter 2014)
- Several companies are developing technology to verify that fracking wells are properly constructed and do not contaminate the area with fracking fluid (Ritter 2014).
  - “Fracking operators often track short-lived radioactive isotope tracers such as  $^{110}\text{Ag}$  or  $^{131}\text{I}$  . . .” (Ritter 2014)
  - FracEnsure “is developing superparamagnetic metal oxide nanoparticle tracers.” (Ritter 2014)
  - Andrew R. Barron of FracEnsure and Rice University believes nanoparticles could help monitor whether injection wells to store industrial wastewater such as fracking fluid remain sealed (Ritter 2014)
  - Oxane Materials supplies ceramic proppant (Ritter 2014)
  - BaseTrace uses artificial DNA to trace fracking fluid (Ritter 2014)

#### **Diverse viewpoints:**

- Companies who benefit from fracking and their employees
  - Energy companies and employeesFracking for natural gas has produced “[t]ens of thousands of new jobs” (Williamson 2012)

- Developers of new technologies
  - “[T]oday’s oil and gas is trapped in rock that is less permeable than concrete, which is why we need fracking,” according to Andrew R. Barron of Rice University and the company FracEnsure.
- Support industries
- Residents who suffer from pollution
  - Pollution from mishandled wastewater, such as West Virginia (Williamson 2012)
  - Noise pollution from fracking, construction, water extraction, and transport
    - Competition for scarce water
      - \* Water is already scarce in western Colorado (Barringer 2013)
      - \* Extracting oil and gas by “fracking” uses large amounts of water (Barringer 2013)
      - \* “...competition and conflicts over water should be a growing concern for companies, policy makers, and investors.” –Report by Ceres (Barringer 2013)
      - \* In south Texas, “as much as one-third of the areas annual ground-water recharge” may be used in fracking (Barringer 2013)
      - \* Engineers at University of Texas, Austin, found that Near Fort Worth, TX, almost 2.9 billion gallons of water were used for fracking in 2011 (Barringer 2013)
  - According to a legal challenge filed by residents in Bartonville, TX, plans to build a tower to provide water for fracking would lead to “a noise nuisance and traffic hazard.” (Gilbert 2014)
- Consumers of energy
  - Increasing the supply of oil and gas has lowered energy prices world-wide.
  - Low oil prices may lead to an economic recession in Russia (Tartar and Andrianova 2014)

## Continuing the outline

Remember that the final paper is only to be 750–1500 words long, and I already have over 700 words, above, without a Discussion or Conclusion. The following Discussion adds nearly another 300 words. Note that all of these word-counts are likely to grow as I connect the outline into paragraphs for the rough draft.

### Discussion:

- Gas-rich shale formations are very far from the aquifer (underground water table), so ground water ought to be unaffected by fracking (Williamson 2012)

- “[F]racking fluid should remain trapped deep below ground or should come back out of the well hole where it can be captured, reused, or disposed of as waste.” (Ritter 2014)
- “Hypothetically speaking, most of the pollution risk from tracking stems from how operators handle the fracking fluid and the waste flowback fluid aboveground . . . [but] accidents happen.” (Ritter 2014)
- “Improved tracers to monitor wayward tracking fluid could provide a level of transparency to allay public concerns.” (Ritter 2014)
- Williamson claims that biocides are “not very different from what’s in your swimming pool,” (Williamson 2012) which is true in that both kill microbes, but chlorine bleach and glutaraldehyde are actually very different chemicals.
- According to John Hanger, Pennsylvania’s former secretary at the Department of Environmental Protection, “If there’s no fracking, the unavoidable consequence would be a sharp increase in oil and coal consumption. Even if environmental and public-health issues were your only concerns—leave aside national security and economic impacts—that fact alone should give you pause.” (Williamson 2012)
- “We are well and appropriately regulated by the state.” (Williamson 2012) –engineer Mark Whitley of Range Resources, working in Pennsylvania
- Water must be clean enough to drink to be discharged in Pennsylvania, so treated water is valuable enough to sell (Williamson 2012)
- Among those complaining about the tower are Rex Tillerson, CEO of Exxon, and former U.S. House Majority Leader Dick Armey (Gilbert 2014)
- Fracking is “a core part of Exxon’s business.” (Gilbert 2014)
- Recycling used water may reduce the conflict (Barringer 2013)
- Recycling may be expensive (Barringer 2013)
- Using “brackish, undrinkable water in place of fresh water” may reduce the conflict (Barringer 2013)

## Finishing the outline

As part of the final complete paper, the Discussion must weigh the various viewpoints. The outline of my Conclusion below (over 200 words) recalls a larger community that does not explicitly appear in the sources I cited. I also propose some responses to questions raised in the articles.

### Conclusion:

- What about climate change? Relatively clean, cheap natural gas is fine, but cheap fuel means more emissions of carbon dioxide. Climate change threatens to cause great harm to many millions of people, most of whom live outside of the U.S. and so see little benefit to fracking.
- The actions of Tillerson suggest that fracking seriously harms the quality of life even in communities only indirectly affected by the practice.
- Williamson points out many benefits of fracking, but his major chemistry error suggests that he is underestimating its risks.
- The Ritter article shows that much work remains to be done to develop technology that can monitor the safety of fracking. I believe large part of the conflict between anti-fracking residents or environmental activists and pro-fracking industry and policy makers is that there is little agreement on how safe fracking really is.
- States and localities probably should and almost certainly will continue to set safety standards. I propose that the federal government require a standard test to be used at all sites. States could then independently decide what constitutes a passing grade, and analysts could study how differing standards affect the environment and quality of life.
- I would also like to see a carbon-tax, so that overall hydrocarbon consumption falls even as it shifts away from dirty oil and dirtier coal toward cleaner sources, such as fracked natural gas.

### Next steps

I estimate that my rough draft will end up well over 1000 words after I link the ideas from the outline into cogent paragraphs. In terms of content, the rough draft seems very nearly done.

Whether you intend to use headings (*e.g.*, Introduction, Viewpoints, Conclusion) in the final draft or not, it is wise to keep them in the rough draft. The headings do not only help the reader—as in writing laboratory reports, the headings force the writer to verify that all the required pieces are in place before submission.

Two more requests, for this assignment and forever:

- **Never attempt to write a rough draft without an outline.** Even a skimpy outline ensures that some pre-writing went into the draft.
- A rough draft is not the same as a first draft. Spell-check, re-read, revise, and repeat.

### Now write.