

2.4 RESOURCES UNIT CASE STUDY: FRACKING

Each unit in this course ends with a capstone case study. The purpose of this case study is to apply what you have learned in the unit to a real earth science situation. In this unit, we have learned about natural resources - minerals, rocks, soil, water, and fossil fuels. We have discussed how these resources form, how they are extracted from Earth, and how they are used by humans. We have also discussed how the extraction and use of these resources by humans impacts Earth.

Now we turn our attention to another local problem. You may have heard the term “fracking” in recent news stories related to the recent boom in the natural gas industry. Wyoming, Pennsylvania, and New York have all been in the news as the fracking industry grows in these states. But Michigan also has important deposits of natural gas, and is poised to be the site of the next fracking boom. Do we want this industry in our backyard? Why is fracking so controversial? In this activity, we will use a model and a series of documents to learn about the process of fracking and the risks and benefits of this industry.

Materials are also designed to meet the following content areas of the Michigan Test for Teacher Certification in Elementary Science (93):

- Describe how human activities affect the hydrosphere.

2.4.1 NATURAL RESOURCES CASE STUDY: WHAT THE FRACK?

Introduction

Oil, coal, and natural gas are the major source of energy in the United States. As we have previously learned, though, petroleum products are non-renewable resources that are becoming ever more difficult to find and extract. A new technology known as deep shale slickwater hydraulic fracturing (often called just “hydrofracking” or “fracking”) provides a way to extract natural gas from previously inaccessible rock formations. This process, however, is highly controversial. What risks are posed by the fracking process to humans and the ecosystem? What are the benefits of this procedure? Do the benefits outweigh the possible risks? In this activity, we will explore the technology and process of fracking and consider these questions as we weigh arguments both for and against fracking in Michigan.

Learning Objectives

By the end of this activity, you should be able to:

- Describe how natural gas is extracted from rock in the process of hydraulic fracturing.
- Describe and evaluate the risks and benefits of this process.
- Evaluate scientific and informed opinion media sources to construct an argument based on evidence that either supports or does not support this practice in a given situation.
- Reflect on the role of science in human affairs and community decisions.

Michigan Science Content Standards

- ESS3-1 (4th grade): *Obtain and combine information* to describe that energy and fuels are derived from natural resources and their uses **affect** the environment.

Before You Begin

1. Think back to our previous activity - what is natural gas? How does it form?
2. How are oil and gas extracted from Earth? What might be the risks of this process?
3. Have you heard of “fracking”? What do you know about this process? Where did you hear this information?

Activity Part 1 – What is Fracking?

Materials

Hydrofracking model Hydrofracking video

Procedure

Before you start, read through *all* of the instructions and Outcome questions for the whole activity, and decide what data you need to collect. Make sure you understand how the activity proceeds before you start.

1. Watch the video describing the fracking process:
<http://www.youtube.com/watch?v=VY34PQUiwOQ>
2. Answer the Outcome questions.

Outcomes Part 1

1. Why is it necessary to fracture shale in order to extract natural gas?
2. Summarize the steps required to drill and hydraulically fracture a well in order to extract natural gas.
3. What is fracking fluid (called “stimulation fluid” in the video) composed of? What is the purpose of the sand added to the fracking fluid? What is the purpose of the chemical additives?
4. What is the source of this video? Why is knowing the source of the video important?

Activity Part 2 – To Frack or Not To Frack, That is the Question

Materials

Scenario sheet

Document packet containing:

1. Cover letter and public statement from PetroFrak drilling application
2. Letter from the Michigan Citizens for a Green Economy
3. Letter from the Newtropolis Economic Development Coalition
4. EPA Report – *Study of Potential Impacts of Hydraulic Fracturing on Drinking Water*
5. Watershed Council publication – *Hydraulic fracturing information sheets 1-5*
6. Nature commentary – *Should fracking stop?*

Procedure

1. Read the scenario so that you know what is expected from the activity.
2. Review the documents (in the separate packet and available on Elearning) among your group. You may ONLY use these documents in reaching your decision – please do not use any other text or web sources!
3. Answer the Outcome questions. Note that grading will be based on the quality of your argument, and how well you support your ideas with evidence from the documents.

Outcomes Part 2

1. As a group, write your responses to the 5 questions on the scenario page.

To Frack or Not To Frack, That is the Question - Scenario

You work as a science teacher at an elementary school in Newtropolis, a (made-up) rural town in Michigan. The town is largely a farming community, but also supported by two small manufacturing plants and a regional hospital. A state-owned property less than a mile from your school is under consideration for a new hydrofracking operation. The energy company applying for the permit, PetroFrak, claims that the operation can be done with little to no impact on the environment or on human health and welfare, plus will bring new jobs to the area. Some citizens and many business owners are excited about the prospects for economic development that the new operation will bring to your town. Other citizens and environmental groups, however, are protesting against the proposed operation because of concerns over toxic chemicals, water usage, pollution, and harm to the environment.

Because the property is so close to the school, your principal and the school board have been getting questions about the proposed operation from concerned parents and citizens. A town hall meeting has been scheduled for next week, and the head of the school board has been asked to make a statement. Your principal has asked your team of science teachers to look into the matter.

Your team of science teachers, because they are knowledgeable about earth science, has been asked to review a set of documents and make a recommendation to the school board based on the scientific evidence in the documents. You may use only these documents and your scientific knowledge to reach your recommendation.

The school board has asked that you respond to several specific questions, and that you also write a final opinion as to whether the board should support the operation. This information will be used to help the board members reach a final decision. The questions are:

1. Summarize 5 important points in favor of supporting the hydrofracking operation.
2. What scientific evidence supports each of these points in favor of the operation? Cite the source (website, letter, paper, etc.) of each piece of evidence.
3. Summarize the 5 key points against supporting the proposed operation.
4. What scientific evidence supports each of these arguments against hydrofracking? Cite the source (website, letter, paper, etc.) of each piece of evidence.
5. Write a short memo (150-200 words) addressed to the school board chairperson that states the final recommendation of your teacher team. Be sure to note the evidence and arguments that support your position.

2.4 CASE STUDY REFLECTION: HOMEWORK (20 points)

Individually answer the following questions that reflect on the Fracking activity. The individual response can be done in class (time permitting) or as homework. A separate Dropbox folder will be available for your responses – create and submit a Word document (like we do in class). These responses will only be reviewed by your instructor. Grading will be based on evidence of careful reflection on the activity and thoughtful responses. Expected responses should be about 300-500 words (2-3 paragraphs).

1. What would be your personal recommendation to the school board (note you might agree or disagree with what your group submitted)? How did you reach this recommendation?
2. Look carefully at the source of each of the documents. Is there any evidence of bias in the documents? Does knowing the source of the information change how you view that information?
3. Use the NSTA textbook to identify one science and engineering practice (pp. 50-57), one cross cutting concept (pp. 58-60), and one disciplinary core idea in earth & space science (pp. 75-79) that relates to class activity 2.4.1 (*Resource Case Study: Fracking*). Explain how the activity relates to each part of the NGSS. Be sure to include the page number for each of the three dimensions.