5E Lesson

Lesson Author(s)	Andrew Groth
Lesson Title	Fracking
Lesson Source	Shale Gas Boom ESRI Map
Technology Needs (if any)	ArcGIS Explorer Online, Computers with internet capabilities
Date Lesson to be Taught	
School	
Supervising Teacher	
Math or Science?	Science
Lesson Concepts	Hydraulic Fracturing

Objectives	• Students will be able to…
	  ○ Define hydraulic fracturing
	  ○ Model the process of hydraulic fracturing
	  ○ Name several different major shale deposits

CO State Standards	• AP Environmental Sciences
	  ○ Standard 04. Investigate earth resources, environmental quality, and global changes.
	  ▪ Determine the types of pollution found in air, water, and soil.
	  ▪ Describe the effects of pollution on aquatic systems, vegetation, natural features, and wildlife.
	  ▪ Describe the impact of pollution on human health.
	• High School Science
	  ○ Standard 1: Physical Science
	  ▪ 5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined
	  ▪ 21st Century Skill
	  • 2. What are the most common forms of energy in our physical world?
	  • 3. What makes an energy form renewable or nonrenewable?

Materials List and Advanced Preparation	Computers with internet capabilities, Projector Computer and projector already on and warmed up Websites already pulled up Demo: Sponge, Clear Container, Water, Tubing, Food Coloring
Safety	No major concerns; however, all other classroom expectations and procedures must be followed.

Accommodations for Learners with Special Needs	Special needs students

1. ENGAGEMENT		**Time: Minutes 10**
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**

• Gain students attention and have them focus on the container
• Describe the materials
• Tell students what the materials represent
  o Tubing = Drill
  o Air = Fracking fluid
  o Sponge = Shale unit
  o Dyed water = Oil/Gas
• Begin demonstration (Will already be built)
  o Slowly blow air into the container
  o Dyed water will begin to ooze and bubble from the sponge once the pressure is high enough
	• What is occurring?
	• Why does the oil ooze from the sponge?
	• What does the air do?
		• Might have to define shale and fracking fluid
		  o Provide sheet with fracking fluid composition
		• Oil excretes from sponge
		• Higher pressure forces oil out of sponge
		• Air provides the pressure

Evaluation/Decision Point Assessment		**Student Outcomes**
Ask what the demonstration is representing Ask students what the different materials represent		Students should begin to understand the process of hydraulic fracturing

2. EXPLORATION		Time: Minutes 10
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**

• Have projector and computer already setup
• Ask the students what they know about fracking
• Ask for definitions
• Prompt the students to watch how the video explains fracking
  ○ http://www.youtube.com/watch?v=lB3FOJjpy7s
	• What is fracking?
	• How is it done?
	• Where is this occurring?
	• Is it anywhere near us?
	• Why is fracking so controversial?
		• Fracking is the fracturing of rock to release fossil fuels
		• Drilling
		• Occurs all over
		  ○ Wherever there's shale
		  ○ Some done around here
		• Possibly harmful to the environment

Evaluation/Decision Point Assessment		**Student Outcomes**
Ask students what is hydraulic fracturing Ask students how the process is done		Students should be able to define hydraulic fracturing and give the basic process of how it's done

3. EXPLANATION		Time: Minutes 40
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**

• Have students work in groups of 3 to 4
• Allow each group to select a shale unit
  ○ Marcellus Shale, Bakken Shale, Eagle Ford Shale, Antrim Shale, Fayetteville Shale, Woodford Shale, Barnett Shale, Haynesville Shale, Utica Shale, New Albany Shale
• Have students create a Poster/PowerPoint/Prezi about their unit
  ○ Poster must include: Name, Location, Size, Depth, Age, Current Fracking Regulation, Estimation on the Number of Current Wells, Estimated Reserves, At Least 2 Interesting Facts
  ○ Information can be found online
  ▪ A lot can be found… http://storymaps.esri.com/stories/2013/ShaleGas/
  ○ Must also include a screenshot from the storymap showing the location of the wells for their shale play
• Prompt students to notice the similarities and differences between the units
• Have each group quickly present their poster in 4 minutes or less
	• What makes your unit unique?
	• What similarities do you see?
	• Where you surprised by the reserve estimation?
	• Can you believe there's that much under us?
		• Size, Location, Depth
		• All within basins
		• All shale
		• Yes/No, I did(n't) know

Evaluation/Decision Point Assessment		**Student Outcomes**
Ask students the similarities and differences between the shale units Check map for understanding		Students should be able to name several different major shale plays in the United States and discuss some similarities and differences between them

4. ELABORATION		Time: Minutes 20
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
• Present own pre-made poster on the Niobrara Fm. • Remind students to look out for similarities and differences between units • Present same facts as the student groups but go into more depth • Talk about how this unit is just east and north of us • Talk about current policies regarding fracking this unit o Mention the current moratoriums on fracking in some northern communities • Mention some environmental concerns	• What makes this unit different? • Surprised this is occurring nearby? • Hope more communities follow Boulder's, Fort Collins', and Loveland's lead?	• Sheer size, Newer play • Sort of, Didn't know the enormity • Yes/No, there should(n't) be a moratorium
Evaluation/Decision Point Assessment		**Student Outcomes**
Ask about the Niobrara Formation See if the students can distinguish this shale unit from the others		Students should be able to describe the Niobrara Formation

5. EVALUATION		Time: Minutes 10
What the Teacher Will Do	**Probing/Eliciting Questions**	**Student Responses and Misconceptions**
• Present students with an AP style question o What is fracking? Where does this happen and what similarities do these areas share? • Students will finish for homework and turn in the following day		

Differentiation	Time: N/A
Students who are behind or need support	For advanced or gifted students
Students that are behind can focus more on the material, instead of the presentation. They can just gather the information together and present it to the class without a fancy and formal PowerPoint/Prezi.	For more advanced students, they can research other shale units while the other groups finish up preparing for their presentation.