Finding information and identifying gaps in information: Fracking

This training is an introduction to some health and safety aspects of hydraulic fracturing, usually referred to as fracking. Fracking is a growing (some say exploding) method of increasing yield from oil and natural gas wells. The technology is used in many states across the country.

In this exercise, written and electronic resources will be used to find information, identify gaps and provide a framework for you to set goals to learn more or to participate in community groups that are interested in fracking.

There are benefits and questions with any technology.

Some Benefits	Some Questions
Jobs	Air
Tax revenue	Water
Energy from the Homeland	Infrastructure (roads, support services)
Support services	Traffic

Using resources during this exercise you will access information and find answers to questions during three activities:

- Review relevant technical terms (Activity 1)
- Identify gaps in information known to you (Activity 2)
- Identify an action that you want to continue regarding fracking (Activity 3)
- Develop a plan to achieve the goal and chart progress and challenges (Activity 3)

This exercise is interactive and you are encouraged to provide feedback. We hope you will share your experiences with implementing the plan developed to learn more about fracking. This will help us document successes and improve training for others by improving information on approaches to potential challenges. We are evaluating training so that it can be improved for the next participants.

Activity 1 - What and Where of Fracking

This activity is opportunity to see some videos clips of fracking, and identify where fracking is being done near you. The facilitator will provide a resource that covers some of the technical terms used in describing fracking operations; you may hear more in the videos and you are encouraged to write down words that you would like to define.

What do fracking operations look like?

Your facilitator will provide a link to a short video that illustrates aspects of the process. Watch it as a whole group, or in small groups.

As you watch,

- Refer to Resource 1—terms and definitions, to find more explanation
- As time allows, use http://www.glossary.oilfield.slb.com/ to find definitions.
- Report back to the group—summarize

  The following terms should be added to the resource

  _____ _____

  _____ _____

  _____ _____

Is fracking being done near you?

- Access www.FracFocus.org or www.fractracker.org/maps/ for a map. Find the well site nearest to your home or work.

If there is no fracking near your home, is it being done near the residence of a friend/relative? Or perhaps someone you know works in the industry.

Nearest fracking to my home or work			**Check nearest to your residence**		
		Well site name			
	Town				
	County				
	Adjoining county				
	State				
	Adjoining state				
A friend/relative lives or works near a well site			Yes	No	N/A

Activity 2 – Potential exposures to workers and residents: known and need-to-know more

There is no clear 'fence' between the workplace of fracking and the community; therefore workplace exposures may affect nearby residents and the larger community.

Chemicals are used in the fluids pumped into wells, but many are proprietary formulations. Sand is used to keep the fractures open (as a proppant) and this is a potential exposure as the material contains silica. Years of exposure to silica can cause lung damage.

Diesel trucks are used to haul water, sand and equipment; not only is the exhaust associated with lung problems, there may be accidents that result in spills and need for emergency response crews.

Your facilitator will provide three Resources.

- Resource 2—chemicals used
- Resource 3—more information
- Resource 4—hierarchy of controls for hazard reduction

Work in small groups, using Resources 1-4, others provided by the facilitator or available to you electronically (iPad, tablet, smartphone) to begin to collect information on known and possible exposures that may occur during the fracking process.

Complete the table on the next page.

Select one of the following for small group discussion and information gathering:

Well site (from Activity 1, above): _____

Material that may get into the air or water (Resource 2): _____

Use of material (if selected for this activity): _____

Physical hazard: _____

For the potential health or safety exposure selected above, complete the parts of the table of interest to your group, below:

	Health or Safety Exposure		**Can hazard be …..? (see Resource 4)**		
Group	Known (documented in a resource)	Possible or Maybe	Reduced	Eliminated	Don't know
Residents					
Workers					

What are gaps in information, where more information would help you?

Report back from your group to the other participants.

Activity 3--What do you want to do and how will you do it?

Now, think about the gaps you have identified, and what you might want to do over the next few months to begin to fill that gap. Complete the table below:

I would like to…

Possible action/activity	**Yes**	**No/don't know**
Get more information for myself or a friend at work		
Get more information for myself as a resident		
Get more information through research and self-education		
Advocate to increase transparency of chemicals in fracking fluids		
Other:		

The next step: make a plan!

Work in small groups of people with the same goal identified in the table above, to develop a plan and timeline.

- What are the steps you need to work toward the goal?
- What barriers do you expect in implementing each step? How can these be overcome?

- What is the measure of success at each step of your plan?
- Who is responsible for each part of the plan?

Use the Worksheet provided (or use your own format) to organize your plan.

Personal plan example (I own all steps and will complete in six weeks)

Goal: Learn more about truck traffic that may be related to fracking in my town

Actions: Park near the QuikEats on Rte 57 (goes toward the fracking operation)

- Count the number of all semis and the number of sand and water trucks
- Possible delay: may need to research how to determine load
- Record times I started and stopped each observation period
    - Vary times of day
- Calculate the percent of trucks that are sand or water
- Share information with Road Commissioner to better plan repair budget
- Share experience with training center: What is the proportion?
- Did you make your report?

Today, report back to the larger group regarding the

- planned steps
- who owns each step
- strategies to overcome barriers
- timeline

We hope you will provide feedback to us as the plan progresses, so we can improve training and document successes from the training. Identifying barriers that are encountered is also important and this information will be used improve training. Our goal is to improve training.

Fracking Resource 1—terms and definitions

Brine—a term applied to produced water (see definition below) because it has high salinity.

Class II brine injection wells—state-regulated disposal sites for fracking waste water (see definition below); must have geology similar to the site of fracking.

CAS—Chemical Abstract Service—provides a unique numerical identifier for each chemical.

Drill cuttings—material brought to the surface as the well is drilled

Drilling mud—used in horizontal drilling (see definition below) to cool and lubricate the drill. There are various formulations including: water-based, potassium chloride/polymer/mineral oil, and synthetic oil.

Erionite—a naturally occurring fibrous mineral prevalent in the Dakotas.

Fracking, the short term for hydraulic fracturing, a process that includes drilling a well and then using liquids under high pressure to crack the rock and release trapped resources (usually oil or gas) that can be extracted

Horizontal—the well bore that causes fracturing is horizontal to surface. This technique can reach along a length as great as 2 miles.

Vertical—only the downward well bore is used. It is much shorter in length than horizontal wells.

Fracking fluid—carries the proppant into the well. Four types, with slickwater being the most common.

Slickwater—90 percent water; remainder is proppants and additives

Gel—gas-based gel (propane, LPG) that returns to the gas phase and can be recovered and reused

Foam—gas-based (nitrogen, carbon dioxide) foam

Diesel based (only fluid covered by Clean Water Act)

Contains volatile organic compounds (VOCs), benzene, toluene, ethyl benzene, xylene (BTEX)

Fracking waste waters

Flowback—fracking and other fluids that are returned to the surface before the well is in operation

Produced water—fluids returned to the surface after the well is in operation

HAP—Hazardous Air Pollutant—defined by the EPA as posing a risk of cancer of other serious adverse health effect as part of the US Clean Air Act.

NORM—Naturally-Occurring Radioactive Material. Radioactive materials are found in rocks and enter the atmosphere from outer space. These occur naturally, and are not the result of human activity. For example, radon (a radioactive gas) is trapped in the rock in Pennsylvania, especially in the so-called Reading prong. NORM includes radon, uranium and decay products, thorium and decay products, radium and decay products and lead-210.

Pits—holding areas for fracking waste waters

Proppant—the material used to keep the fracture open, so that extraction can occur. The material must be strong, but allow for permeation of the gas/oil for extraction. Silica sand is used frequently, but it must be sufficiently cleaned of 'fines' to prevent plugging. Coating silica with resin reduces 'fines'. Other proppants include ceramic and glass.

Radioactive tracers—small amounts of radionuclides added to document the profile of the well.

SDWA—Safe Drinking Water Act, federal statute regulating drinking water. Administered by EPA.

Separation pits—Large settling pits, where solids are separated from liquids by allowing the heavier materials such as drill cuttings from the liquids (water and drill fluids) to settle to the bottom.

Stages of the hydraulic fracturing process - perforating the casing; shale fracturing; frack fluid removal; flaring; and harvesting the natural gas.

TENORM—Technology-Enhanced Naturally Occurring Radioactive Material—Human activity can alter the concentration of NORM (see above). This is similar to the salt concentration rising in a bucket of salt water, as the water evaporates. Activities related to natural gas exploration and drilling can result in wastes that have a higher concentration of radioactive material than the rock or fluids in the rock had before the activity.

See also: http://www.glossary.oilfield.slb.com/ (Accessed 20 November 2015)

Resource 2-- Chemicals used

Water is the major liquid used in fracking; however, because of the large quantity of water, the overall amount of chemicals can be of interest. The following three tables in this Resource are taken from:

UNITED STATES HOUSE OF REPRESENTATIVES

COMMITTEE ON ENERGY AND COMMERCE MINORITY STAFF. Chemicals used in hydraulic fracturing. **http://www.conservation.ca.gov/dog/general_information/Documents/Hydraulic%20Fracturing%20Report%204%2018%2011.pdf** **(accessed 20 November 2015)**

Table 1. Chemical Components Appearing Most Often in Hydraulic Fracturing Products Used Between 2005 and 2009

Chemical Component	No. of Products Containing Chemical
Methanol (Methyl alcohol)	342
Isopropanol (Isopropyl alcohol, Propan-2-ol)	274
Crystalline silica - quartz (SiO2)	207
Ethylene glycol monobutyl ether (2-butoxyethanol)	126
Ethylene glycol (1,2-ethanediol)	119
Hydrotreated light petroleum distillates	89
Sodium hydroxide (Caustic soda)	80

Table 2. States with the Highest Volume of Hydraulic Fracturing Fluids Containing 2-Butoxyethanol (2005-2009)

State	Fluid Volume (gallons)
Texas	12,031,734
Oklahoma	2,186,613
New Mexico	1,871,501
Colorado	1,147,614
Louisiana	890,068
Pennsylvania	747,416
West Virginia	464,231
Utah	382,874
Montana	362,497
Arkansas	348,959

The oil and gas service companies used hydraulic fracturing products containing 29 chemicals that are (1) known or possible human carcinogens, (2) regulated under the Safe Drinking Water Act for their risks to human health, or (3) listed as hazardous air pollutants under the Clean Air Act. These 29 chemicals were components of 652 different products used in hydraulic fracturing. Table 3 lists these toxic chemicals and their frequency of use.

Table 3. Chemicals Components of Concern: Carcinogens, SDWA-Regulated Chemicals, and Hazardous Air Pollutants

Chemical Component	Chemical Category	No. of Products
Methanol (Methyl alcohol)	HAP	342
Ethylene glycol (1,2-ethanediol)	HAP	119
Diesel19	Carcinogen,SDWA, HAP	51
Naphthalene	Carcinogen, HAP	44
Xylene	SDWA, HAP	44
Hydrogen chloride (Hydrochloric acid)	HAP	42
Toluene	SDWA, HAP	29
Ethylbenzene	SDWA, HAP	28
Diethanolamine (2,2-iminodiethanol)	HAP	14
Formaldehyde	Carcinogen, HAP	12
Sulfuric acid	Carcinogen	9
Thiourea	Carcinogen	9
Benzyl chloride	Carcinogen, HAP	8
Cumene	HAP	6
Nitrilotriacetic acid	Carcinogen	6
Dimethyl formamide	HAP	5
Phenol	HAP	5
Benzene	Carcinogen, SDWA, HAP	3
Di (2-ethylhexyl) phthalate	Carcinogen, SDWA, HAP	3
Acrylamide	Carcinogen, SDWA, HAP	2

Chemical Component	Chemical Category	No. of Products
Hydrogen fluoride (Hydrofluoric acid)	HAP	2
Phthalic anhydride	HAP	2
Acetaldehyde	Carcinogen, HAP	1
Acetophenone	HAP	1
Copper	SDWA	1
Ethylene oxide	Carcinogen, HAP	1
Lead	Carcinogen, SDWA, HAP	1
Propylene oxide	Carcinogen, HAP	1
p-Xylene	HAP	1
Number of Products Containing a Component of concern		**652**

See the source cited above, Appendix A, for an extensive listing of additives to fracking fluids identified by reading MSDS information, as described here: To compile this list of chemicals, the US House of Representatives Committee on Energy and Commerce minority staff reviewed each Material Safety Data Sheet provided to the Committee for hydraulic fracturing products used between 2005 and 2009. These Committee staffers transcribed the names and CAS numbers as written in the MSDSs; as such, any inaccuracies on this list reflect inaccuracies on the MSDSs themselves.

A 2015 report by EPA scientists shows the results of reviewing more than 38,000 disclosures filed with FracFocus (http://www2.epa.gov/sites/production/files/2015-03/documents/fracfocus_analysis_report_and_appendices_final_032015_508_0.pdf, accessed 20 November 2015). Included is the volume of water reported in disclosures by state (ND, 4,789 million gallons (mg); OH, 614 mg; MI 55 mg) and a summary of concentrations of the 20 most frequently reported additives used in Dunn County ND (Table G-3 page 136).

Resource 3-- More information

Videos/Media (accessed 20 November 2015)

YouTube: Hydraulic Fracturing in Modern Drilling Operations: http://www.youtube.com/watch?v=Eu8VqiiJq1M

Hydraulic Fracturing—Shale Natural Gas Extraction: http://www.youtube.com/watch?v=lB3FOJjpy7s

North Dakota Oil Frac Water: http://www.youtube.com/watch?v=GwLt5t7vABM

Chesapeake Energy Hydraulic Fracturing Method: http://www.youtube.com/watch?v=7ned5L04o8w

TrialExhibits: http://www.youtube.com/watch?v=fFUxq9UolN4

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

National Public Radio (NPR) examples; (accessed 20 November 2015)
http://www.npr.org/2012/05/14/152653966/npr-series-to-examine-fracking

http://www.npr.org/series/151930969/science-and-the-fracking-boom-missing-answers

http://www.npr.org/2012/05/17/152268501/pennsylvania-doctors-worry-over-fracking-gag-rule

http://www.npr.org/2015/06/07/412633615/both-sides-claim-victory-over-epa-fracking-study

http://www.npr.org/2015/10/13/448182616/study-may-ease-drinking-water-worries-about-fracking

http://www.npr.org/sections/thetwo-way/2015/03/20/394282086/interior-dept-issues-new-fracking-rules-for-federal-lands

CBS television accessed 4 January 2013

http://www.yidio.com/show/dan-rather-reports/season-5/episode-14/links.html

New York Times, February 3, 2013

http://www.nytimes.com/2013/02/03/magazine/north-dakota-went-boom.html?pagewanted=6&_r=0&hp

Websites to follow—all accessed 20 November 2015

www.FracFocus.org; www.fractracker.org/maps/;www.nrdc.org/energy/gasdrilling
www.niosh.gov search on fracking ; www.osha.gov search on fracking
http://www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_related_topics/20349

www.epa.gov/hydraulicfracture and www.epa.gov/hfstudy

www.theOEC.org (Ohio)

www.watershedcouncil.org (search on fracking, Michigan)

www.ndhealth.gov/ehs/ (North Dakota)

Hazard assessment and control

Erionite: http://blogs.cdc.gov/niosh-science-blog/2011/11/erionite/

NIOSH investigates exposures: http://blogs.cdc.gov/niosh-science-blog/2014/08/21/flowback-2/

NIOSH/OSHA Alert: http://www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.html

e-tools: http://www.osha.gov/SLTC/etools/oilandgas/servicing/special_services.html

hazcom interpretive guidance: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=20121

OSHA standards and guidance: http://www.osha.gov/SLTC/oilgaswelldrilling/index.html

Rig inspection checklists: http://www.cdc.gov/niosh/docs/2011-204c/

Effect on drinking water: www.epa.gov/hfstudy/pdfs/hf-report20121214.pdf

Safety alerts, International Association of Drilling Contractors http://www.iadc.org/safety-alerts/

STEPS network (Service, Transmission, Exploration and Production Safety)

http://www.stepsnetwork.com/

Research agendas

NIOSH: http://www.cdc.gov/niosh/programs/oilgas/projects.html

EPA: www.epa.gov/hfstudy/HF_Study_Plan_110211_FINAL_508.pdf, EPA drinking water research agenda, progress and draft report 2015.

Health assessment, PA: search periodically on Geisinger fracking health study (Geisinger is a clinic in Danville PA that provides health services in 44 counties where fracking is ongoing; data will be used to evaluate whether health outcomes are related to fracking.)

Published research
https://stateimpact.npr.org/pennsylvania/2015/06/08/report-cites-lack-of-data-on-fracking-health-issues/
http://hub.jhu.edu/2015/10/12/fracking-pregnancy-risks

Resource 4-- Hierarchy of Controls for hazard reduction

Control		Highest preference
	Eliminate	↓
	Substitute	
Prevent		
	Modify	
	Contain	
	Ventilate	
	Work Practice Change	
	Personal Protective Equipment	Lowest preference

This scheme illustrates that the best and surest approaches to hazard reduction is to eliminate the exposure or substitute a lesser hazard; the prevention strategies rely on modifying the process, contain (build a box), removing through ventilation, a change in work practice that must be done diligently (day after day) or use of personal protective equipment (that may not be 100% effective even when used and maintained diligently.

Worksheet : Build a plan

Goal: _____

Plan action item		Who 'owns' each action	Anticipated barriers and approach to each	Date to be completed	Reason for Delay	Date done
Action 1.						
Action 2.						
Action 3.						
Action 4.						
Action 5.						
Action 6.						
Action 7.						
Action 8.						
Action 9.						
Finalize work plan and set deadlines for each action						
Report final results to participants/community						
Report results to Training Center						