Natural Gas Activities

2015-2016

Grade Levels:

- Elem Elementary
- Int Intermediate
- Sec Secondary

Subject Areas:

- Science
- Social Studies
- Language Arts
- Technology

NEED
National Energy Education Development Project

Teacher Advisory Board

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The mission of The NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

Teacher Advisory Board Statement

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

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Energy Data Used in NEED Materials

NEED believes in providing the most recently reported energy data available to our teachers and students. Most statistics and data are derived from the U.S. Energy Information Administration's Annual Energy Review that is published yearly. Working in partnership with EIA, NEED includes easy to understand data in our curriculum materials. To do further research, visit the EIA website at www.eia.gov. EIA's Energy Kids site has great lessons and activities for students at www.eia.gov/kids.

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National Energy Education Development

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Liquefied Natural Gas Materials

The following is a list of materials, other than paper and pencil, needed to complete the activities in this curriculum guide. Most materials are common lab items, or items that can easily be sourced at a grocery or big box store. If you have questions or have trouble locating a material, call NEED for assistance.

ACTIVITY	MATERIALS NEEDED
Natural Gas Chain	▪String or yarn
Careers in the Natural Gas Industry	▪Computers with internet access
A Nifty Natural Gas Story	▪Yellow ball ▪Long pieces of yellow ribbon ▪Artificial plants ▪Sock puppets ▪Large pieces brown and black paper and cardboard ▪Long, hollow, cardboard tube (such as from paper toweling or wrapping paper) ▪Plastic mixing bowl or bottle ▪Two long pieces of garden hose or tubing ▪Small butane lighter
Natural Gas in the Round	

Teacher Guide

Grade Levels

- Intermediate, grades 6–8
- Secondary, grades 9–12

Time

- 4-6 class periods

Additional Resources

- For more information on natural gas as a resource, as well as all of the other sources of energy, reference NEED's *Energy Infobooks*. These infobooks are available for download at any reading level at www.NEED.org.
- For more information on the exploration and production of natural gas, check out NEED's oil and natural gas curricula. *Wonders of Oil and Gas*, for elementary learners, and *Exploring Oil and Gas* for intermediate and secondary learners are available for download at www.NEED.org.
- A booklist of fiction and non-fiction energy related books can be found at www.NEED.org

Background

When students think of energy, they most often are thinking of electricity; however, a significant proportion of our total energy is supplied by natural gas, and as more natural gas is unlocked from shale deposits, that proportion will continue to increase. The purpose of these activities is to help students understand how natural gas is used in the energy industry. At the conclusion of this mini-unit, students will be able to identify ways natural gas is used, produced, and safely handled, and be able to discuss careers directly involved in the natural gas industry.

Preparation

- Access Energy Infobooks or the appropriate oil and gas curriculum guide from NEED's website, www.need.org/curriculum. Copy student informational text pages as needed, or make digital copies of these guides available to your students for content area reading.
- Read through the activities, making copies where indicated.
- Gather the materials listed for each activity.
- Prepare a projection copy of the *Natural Gas Production to Market* master, page XX.

The Natural Gas Chain

Objectives

- Students will be able to list and describe the different steps needed to produce natural gas and bring it to market.
- Students will be able to provide examples of how a global natural gas system can be affected by one weak link in the chain.

Materials

- *Natural Gas Production to Market* Master
- *Natural Gas as a System Hangtags*
- *The Natural Gas Chain* worksheet
- String or yarn

Time

- Two class periods, plus homework

Preparation

- Make copies of the worksheets for each student.
- Cut out the hangtags. Fold each on the dotted line. Punch a hole through the folded card, and attach string so that a student may wear it around his or her neck. Assemble multiple sets to fit the number of students in the class, if necessary.
- Divide the students into groups of eight.

✔ Procedure

NATURAL GAS PRODUCTION TO MARKET

1. Explain to the students that natural gas is typically found in a gaseous state.
2. Ask students what they think happens to a resource when it is found far from cities or industry. Is it helpful to customers? (Known as stranded resources, natural gas located in undesirable locations can be transported via pipeline to marketable locations.)
3. Have students review the *Natural Gas Production to Market* master and write information about each step on a sheet of paper, or provide a copy of the master for each student and assign as homework.

NATURAL GAS AS A SYSTEM

1. Distribute the system hangtags to the students, providing one set to each group of eight.
2. Ask students to read the backs of their cards and review their Natural Gas Production to Market information. Allow time for questions about roles or the process involved. It may be helpful to project the master briefly.
3. Have each group put on their hangtags and stand in a circle with one student holding the ball of yarn.
4. Explain that the first students should look around the circle and identify a part of the system that relates to his/her component. Have the first student hold onto one end of the yarn, say the name of the related component, and toss the ball of yard to that student. The first student then explains how their parts are related.
5. Have the groups repeat the process until all students have caught and tossed the ball of yarn. In the end, there will be a web of yarn connecting all students in the group. In some cases, students may need to catch the ball of yarn twice.
6. Have one student give a tug on the string. Ask the students that felt the tug to explain how a stress on one component affected their role card. For example, a Production tug might cause an attached Processing tag to say, "If production of natural gas falls, the processing facility cannot distribute enough natural gas to residences to keep them warm."
7. Continue this process with each student tugging and suggesting different ways the system could be affected. Students should be able to explain various ways a change in one part of the system might affect other parts in the system. Students should also be able to identify ways the chain could be assembled differently and explain why.

THE NATURAL GAS CHAIN

1. Distribute copies of *The Natural Gas Chain* worksheet to each student.
2. Explain that each student should choose one step in the natural gas chain and write it in the center circle. The outside circles should be labeled with the seven remaining steps.
3. Have students write inside the arrow a way the inner component affects the outside one and a way the outer component affects the inner one. Assign as homework if students do not finish in class.

Careers in the Natural Gas Industry

✪ Objective

- Students will be able to identify and describe careers in the natural gas and energy industries, and list skills and qualifications for each job description.

Materials

- Computers with internet access
- *Career Networking Template*

Time

- One class period, plus homework

Preparation

- Make a copy of the template for each student, or provide a digital copy to project or share with students.

✔ Procedure

1. Have students research some careers in the natural gas and energy industries. A list is found on page XX.
2. Allow students time to research other careers that are not listed. Ask students to select a career they would like to research further or might have an interest in.
3. Explain to students that they will be constructing a career profile, much like a digital résumé used in online networking sites for employment.
4. Instruct students to create a profile using the basic information requested on the template. You may wish to specify more or less items depending on the depth of the profile you might like them to complete. Profiles can be created on paper or using a software of your choice.

A Nifty Natural Gas Story

✪ Objective

- Students will be able to explain the energy transformations or flows involved with natural gas, from production to use.

Materials

- Art supplies or props as listed
- *A Nifty Natural Gas Story* master
- *A Nifty Natural Gas Story Pantomime*

Time

- One or two class periods

Preparation

- Make a copy of *A Nifty Natural Gas Story Pantomime* for each student
- Provide art supplies for students to assemble their props, or gather the suggested items or reasonable substitutes as shown on the handout

✔ Procedure

1. Assign students to a specific role on the pantomime sheet.
2. Discuss how natural gas is produced, processed, transported, and used.
3. Have each student assemble his/her props, or provide each student with a suggested prop.
4. Review or introduce any new vocabulary as needed. Project the story. Act out the story from beginning to end. Extra students may help read the story aloud.
5. Substitute in different students or props as necessary.
6. Ask students to write an essay explaining the energy flow involved to produce electricity from coal.

Natural Gas in the Round

✪ Objectives

- Students will be able to describe properties of natural gas.
- Students will be able to list the steps in the natural gas chain
- Students will be able to list uses for natural gas.
- Students will be able to identify safety features provided within the natural gas utility system.

Materials

- *Natural Gas in the Round* cards
- Scissors

Time

- One class period

Preparation

- Make two copies of the sheets of cards.
- Cut one set of cards into individual pieces. The other will serve as the answer key, as the clues are in the correct order on the pages.

✔ Procedure

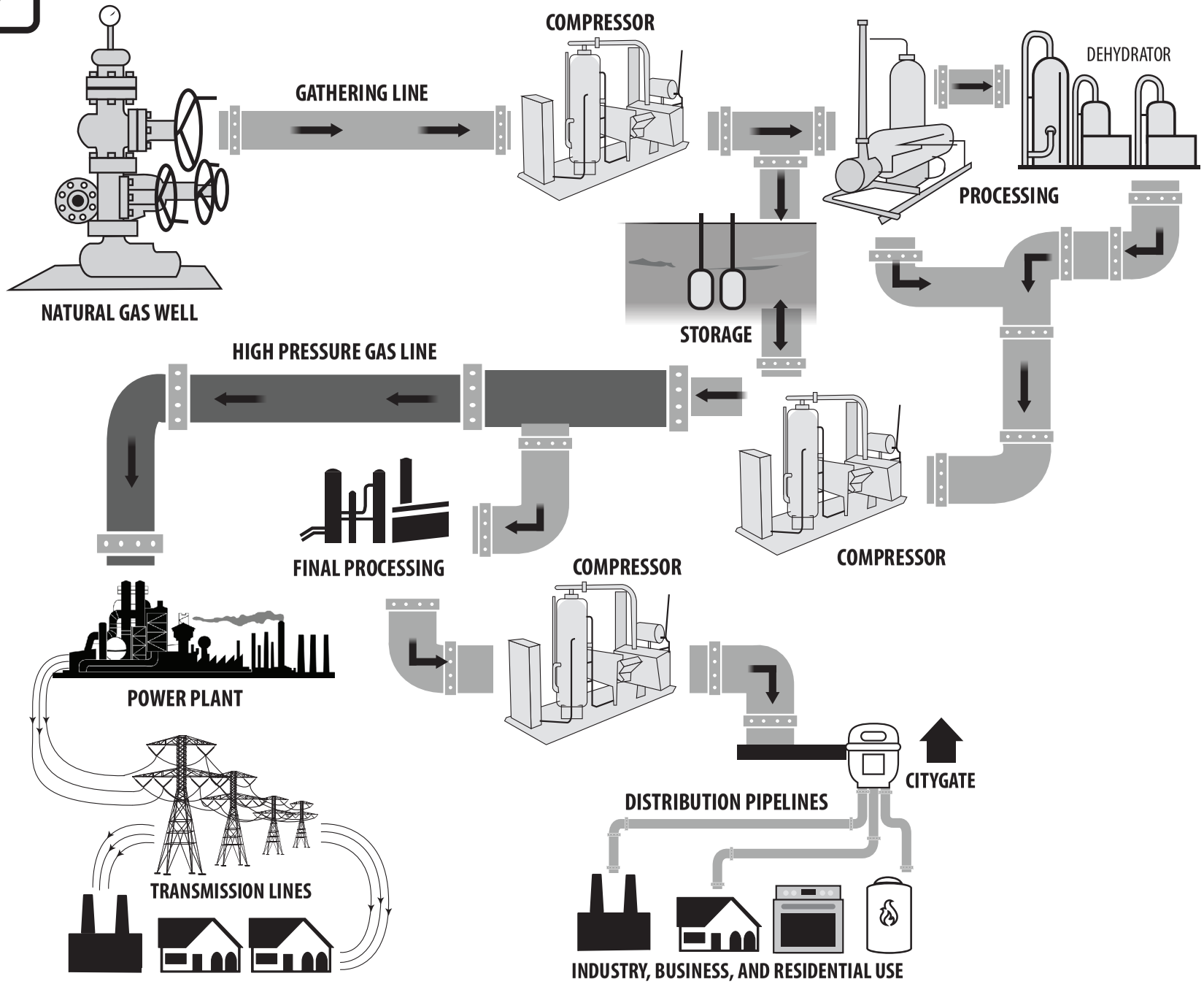
1. Distribute one card to each student. If you have cards left over, give some students two cards until all of the cards are distributed.
2. Have students look at the bolded statement at the top of the cards. Give them a few minutes to review the information about their statement using the background information in their previous reading assignments.
3. Choose a student to begin the game. Give the following instructions:

    a. Read the question on your cards. The student with the correct answer will stand up and read the bolded answer.

    b. That student will then read his/her question. The game will continue until the student that started the game stands up and answers a question.

    c. Students should discuss as a class and come to a consensus if there is a disagreement on a student answer. Use the answer key to assist, if needed.

Natural Gas Production to Market



Careers in the Natural Gas Industry List

There are three segments of the natural gas industry: upstream, midstream, and downstream. Exploration and production activities are part of the upstream segment. Midstream activities include processing, storage, transport, utility companies, chemical refining, and distribution of products are considered upstream components. All of the following careers fit into one of these segments. While not all of these careers are strictly employed within the natural gas industry, all are important to its function.

Architect
Surveyor
Civil Engineer
Electrical Engineer
Mechanical Engineer
Petroleum Engineer
Architectural and Civil Drafter
Surveying and Mapping Technician
Civil Engineering Technician
Electronics Engineering Technician
Environmental Engineering Technician
Mechanical Engineering Technician
Chemical Technician
Occupational Health and Safety Technician
Construction Manager
Supply Chain Manager
Risk Management Specialist
Supervisor of Construction and Extraction
Supervisor of Installers, Mechanics, Repairers
Supervisor of Production and Operation
Production, Planning, and Expediting Clerk
Carpenter
Construction laborer
Operating Engineer
Pipelayer
Plumber, Pipefitter, Steamfitter
Construction and Building Inspector
Derrick Operator
Rotary Drill Operator
Service Unit Operator
Earth Driller
Roustabout
Extraction Worker
Mobile Heavy Equipment Mechanic
Industrial Machinery Mechanic
Electrical Power-line Installer and Repairer
Telecommunications Line Installer
General Maintenance and Repair Worker
Installation, Maintenance, Repair Worker
Machinist
Welder, Cutter, Solderer, Brazer
Plating and Coating Machine Setter, Operator, and Tender, Metal and Plastic
Gas Compressor and Gas Pumping Station Operator
Wellhead Pumper
Heavy Truck and Tractor Driver
Industrial Truck and Tractor Operator

A Nifty Natural Gas Story

Hundreds of millions of years ago, long before the dinosaurs roamed, most of the Earth was covered with vast, deep oceans. Tiny plants and animals lived in these oceans.

The sun's radiant energy was changed into chemical energy by the plants, which helped them grow. The animals ate the plants, and both the plants and animals stored the sun's energy in their bodies as chemical energy.

When they died, they sank to the ocean floor. As more and more plants and animals died, they sank and made a thick layer deep under the water.

Over time, more layers of rock, sand, and other dead plants and animals built up. As the layers built up, they pressed down hard on the layers beneath.

As the layers of rock built up, the deepest layers got hot. They were under very high pressure with all that weight on top of them.

Eventually, those dead plants and animals under all those layers of rock changed. Now they weren't plants or animals. Now they were special molecules called hydrocarbons, with only hydrogen and carbon in them.

The hydrocarbons became trapped in tiny holes in the rocks. Then they waited.

And waited.

And waited some more - millions of years!

Many years ago, people began to notice bubbles coming out of the ground beneath ponds and lakes. They discovered that the bubbles were flammable – they could fuel a fire. The people used bamboo and other hollow plant stems to carry the bubbling gas to their villages.

Today, geologists search for the layers of rock that contain the hydrocarbons. They use a lot of special equipment and computers to find natural gas. Then they drill an exploratory well. Eight or nine times out of ten, they are successful!

The natural gas is pumped out of the ground at the well. It is separated from any liquids and water that might be mixed with it, and compressed into high pressure gas pipelines. The gas moves to the processing facility.

Natural gas has no odor, so at the final processing facility, a chemical called mercaptan is added. Mercaptan smells like rotten eggs! That is what you smell if natural gas is leaking.

After processing, electrical power plants might use natural gas to generate electricity for homes, businesses, and schools. Most homes also use natural gas to heat water and stay warm in cold weather.

Natural gas produces almost no air pollution when it is burned. Because it is flammable, it is important to use it safely. If you ever smell natural gas, leave the area immediately and then call 911.

All of those tiny plants and animals millions of years ago are now providing us a clean energy source that is easy to use. Do you think they would be happy to know so many people rely on them?

A Nifty Natural Gas Story Pantomime

Students will demonstrate the flow of energy to heat homes using props. Depending on the audience, signs with the different forms of energy can be used by the students to identify the energy transformations. This activity with different props can also be used to demonstrate other energy flows, like coal to electricity, biodiesel, ethanol, etc.

Sun – Nuclear Energy		Nuclear fusion in the sun produces vast amounts of energy
	Prop & Action	Yellow ball
Radiant Energy		The sun's radiant energy is transferred to Earth by electromagnetic waves.
	Prop & Action	Long pieces of yellow ribbon; students wave the ribbon in the air
Chemical Energy		Radiant energy is absorbed by tiny green plants in the ocean and changed to chemical energy by photosynthesis.
	Prop & Action	Artificial plants or paper "seaweed"; students move up from the floor and "float" around
Storing Chemical Energy		Tiny animals in the ocean ate the plants and stored their chemical energy.
	Prop & Action	Sock puppets; sock puppet animals "eat" the plants
Natural Gas Formation		The tiny plants and animals died. Over millions and millions of years, they were covered by many layers of dirt and rock. The high pressure changed them into natural gas.
	Prop & Action	Large pieces of brown and black paper and cardboard (several different types and colors); plants and sock puppets are dropped to the floor and the layers of "sediment" are stacked on top of them.
Natural Gas Exploration and Production		A well is drilled into the ground to locate natural gas. The gas is brought out of the ground through the well.
	Prop & Action	Long, hollow cardboard tube, or a rolled-up piece of paper; hold the tube vertically with hands over the head, and push the tube downward to the floor. Use one hand to wave fingers over the top of the tube in a wiggling motion to indicate the flowing of natural gas.
Separation, Dehydration, and Compression		The raw natural gas from the ground is separated from impurities and water, and compressed to high pressure.
	Prop & Action	Plastic mixing bowl or bottle; student uses hand to simulate separating the gas from the impurities, and another student pushes both hands together in a compressing motion to load the "gas" into the "pipeline"
Processing		At the processing facility, a chemical called mercaptan is added to the gas to make it smell like rotten eggs.
	Prop & Action	One long piece of garden hose or other tubing, and one eye dropper; one student holds the tubing from the separator to the processing facility, and one student holds the end of the tubing in one hand and the dropper in the other. The dropper is used to simulate adding mercaptan to the gas
Distribution		The processed gas is transported by pipeline to businesses and homes.
	Prop & Action	Another long piece of garden hose or other tubing; student holds it between the processing facility and the end use location
End Use – Thermal Energy		In our homes, natural gas is burned to heat water and keep us warm in cold weather.
	Prop & Action	Small lighter; student (or adult) lights the lighter and other students hold their hands up to the flame to indicate they are being warmed by the fire.

Career Networking Template

LinkedIn™

Steve Surveyor

Surveying Engineer | Map It Mine It Market It, Inc.

Pennsylvania

Current	Map It Mine It Market It, Inc.
Past	Photogrammetric Technician, Map It Mine It Market It
Education	Michigan Technological University

National Society of Professional Surveyors http://www.nsps.us.com/index.cfm?&stopRedirect=1
Michigan Technological University http://www.mtu.edu/admissions/programs/majors/surveying/

Summary

Engineer working for Map It, specializing in GIS technology and photogrammetry.

Specialties

- GIS technology
- Photogrammetry
- Digital Cartography

Education

Michigan Technological University
Bachelor of Science, Surveying Engineering

Experience

Map It Mine It Market It, Inc.
2007 – present
- Develop contoured mapping data for natural gas exploration
- Contribute to site development planning for natural gas production
- Manage surveying team of 7-10 individuals on site

LinkedIn™

Current

Past

Education

Summary

Specialties

-
-
-

Education

Experience

-
-
-
-

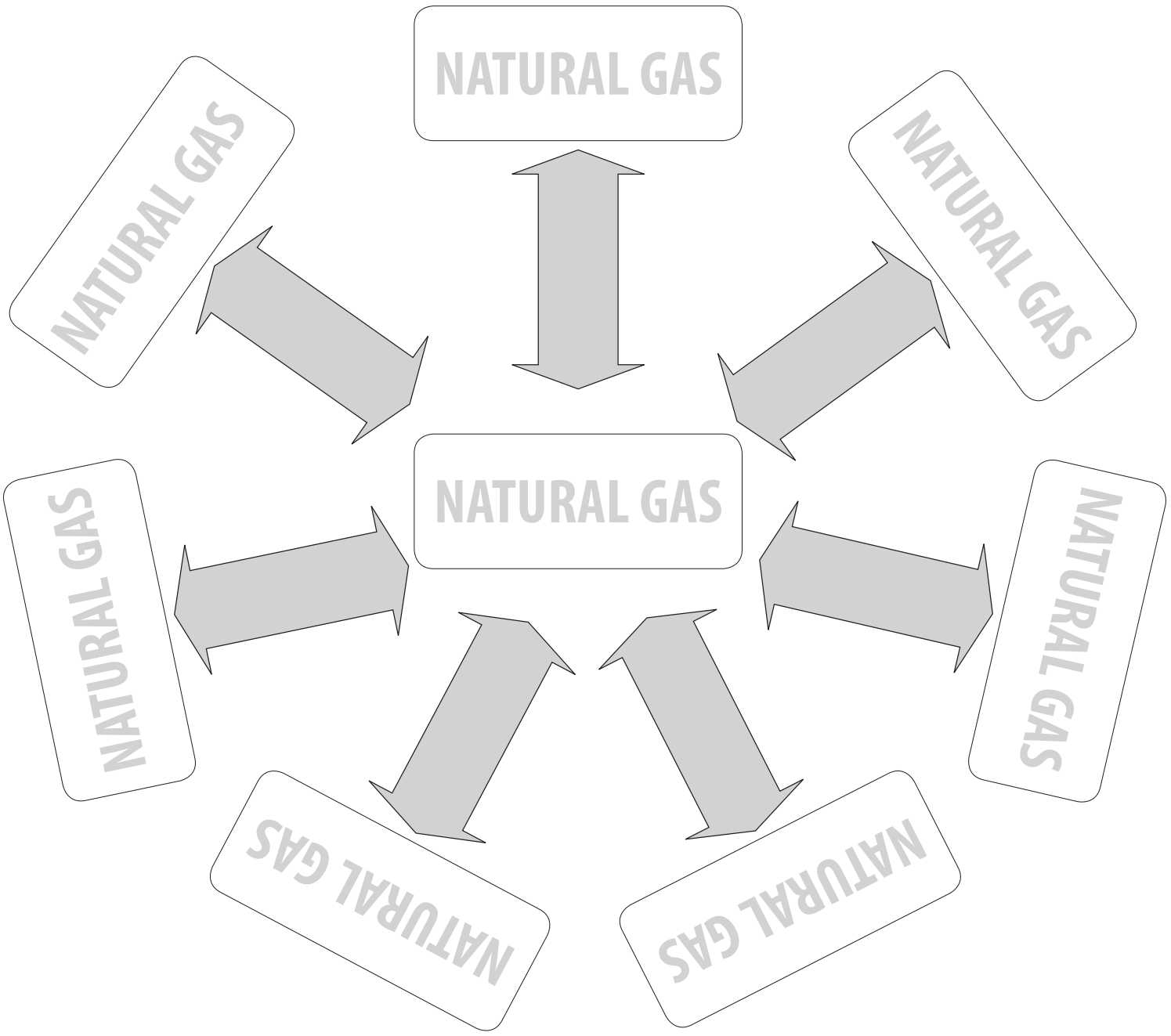
Natural Gas as a System

Exploration	**The process of finding natural gas deposits.**
Production	**The process of drilling wells and bringing hydrocarbons to the surface.**
Separation and Dehydration	**The process of removing water vapor and liquid aerosols from natural gas so it is of a good quality for pipeline transportation.**
Storage	**Underground formations can be used to store natural gas at low demand times, so it is available at peak demand times.**

Transportation	**Natural gas is moved through an extensive network of interstate and intrastate pipelines.**
Compression	**Increasing the pressure of natural gas at compressor stations every 40-100 miles along the pipeline system.**
Distribution	**Utility companies deliver natural gas to consumers through a citygate.**
End Use	**Industry, businesses, and residential users all need natural gas for heating, cooking, manufacturing products, and generating electricity.**

The Natural Gas Chain

Choose one step in the NG chain and write it in the center box. Label the outside boxes with the seven remaining steps. In the arrows connecting the NG steps, write a way the center step affects the outside step as well as a way the outside step affects the inside one.



Natural Gas in the Round

***Natural Gas in the Round* is a quick, entertaining game to reinforce vocabulary and information about natural gas, its properties, safety, and its delivery to us as consumers.**

Grades

- 5–12

Preparation

- 5 minutes

Time

- 10–20 minutes

"In the Rounds" are available on several different topics. Check out these guides for more, fun "In the Round" examples!

- Energy in the Round—*Energy Games and Icebreakers*
- Hydrogen in the Round—*H_2 Educate*
- Oil and Gas Industry in the Round—*Fossil Fuels to Products*, *Exploring Oil and Gas*
- Conservation in the Round—*Monitoring and Mentoring*, *Learning and Conserving*
- Forms of Energy in the Round—*Science of Energy* guides
- Solar Energy in the Round—*Energy From the Sun*
- Uranium in the Round—Nuclear guides
- Transportation Fuels in the Round—*Transportation Fuels Infobooks*

Get Ready

- Copy the *Natural Gas in the Round* cards onto card stock and cut into individual cards.
- Make an additional copy to use as your answer key. These pages do not need to be cut into cards.
- Have the *Student Informational Text* available.

Get Set

- Distribute one card to each student. If you have cards left over, give some students two cards so that all of the cards are distributed.
- Have the students look at their bolded words at the top of the cards. Give them five minutes to review the information about their words using the *Student Informational Text*.

Go

- Choose a student to begin the round and give the following instructions:
  - Read the question on your card. The student with the correct answer will stand up and read the bolded answer, "I have _____."
  - That student will then read the question on his/her card, and the round will continue until the first student stands up and answers a question, signaling the end of the round.
- If there is a disagreement about the correct answer, have the students listen to the question carefully looking for key words (forms versus sources, for example) and discuss until a consensus is reached about the correct answer.
- Follow along with students using your answer key. Mark off the starting card, so you remember where you started and ended. The cards go in order vertically in each column.

Alternative Instructions

- Give each student or pair a set of cards.
- Students will put the cards in order, taping or arranging each card so that the answer is directly under the question.
- Have students connect the cards to fit in a circle or have them arrange them in a column.

Natural Gas in the Round Cards

I have 811. Who has the name of natural gas trapped within coal seams underground?	**I have Fredonia, New York.** Who has the sector of the economy that uses natural gas to manufacture products?
I have coalbed methane. Who has a device that removes water from natural gas?	**I have Industry.** Who has what you should do if you smell natural gas?
I have dehydrator. Who has electrons moving through a conductor?	**I have leave immediately and call 911.** Who has the name for natural gas trapped in ice crystals?
I have electricity. Who has the name for determining likely locations of natural gas deposits?	**I have methane hydrate.** Who has energy sources that are not easily replenished?
I have exploration. Who has the site of the first natural gas well?	**I have nonrenewable.** Who has the device that is most often used to transport natural gas?

I have pipeline. Who has the step in the natural gas chain that includes natural gas wells?	**I have biogas.** Who has the machine that increases the pressure of natural gas so it can be transported?
I have production. Who has the type of rock formed by layers of silt, soil, and other deposits?	**I have compressor.** Who has when natural gas is sent to various sites for end use?
I have sedimentary. Who has a type of rock in which natural gas can often be found?	**I have distribution.** Who has the ability to do work or cause a change?
I have shale. Who has two states that produce the most natural gas?	**I have energy.** Who has the name of energy sources produced from ancient plants and/or animals?
I have Texas and Pennsylvania. Who has the name of natural gas produced from decomposing plant matter and waste?	**I have fossil fuel.** Who has a class of molecules made from only hydrogen and carbon that includes natural gas?

I have hydrocarbon. Who has the name for natural gas produced where trash is deposited?	**I have porous.** Who has the sector of the economy that uses natural gas primarily to heat water and living spaces?
I have landfill gas. Who has the chemical with a strong odor that is added to natural gas so it can be detected without special equipment?	**I have residential.** Who has the device that isolates natural gas from liquids and other contaminants when it comes out of the well?
I have mercaptan. Who has the organisms from which most natural gas was formed?	**I have separator.** Who has the step in the natural gas chain where natural gas is held until times of high demand?
I have microscopic plants and animals. Who has the property of rocks which allow fluids to easily move?	**I have storage.** Who has the site where a hole is drilled into the ground to obtain natural gas?
I have permeable. Who has the property of rocks that can hold lots of fluids?	**I have well.** Who has the number everyone must call to locate natural gas pipelines before digging?

Natural Gas Activities Evaluation Form

State: _____ **Grade Level:** _____ **Number of Students:** _____

1. Did you conduct the entire unit?	❑ Yes	❑ No
2. Were the instructions clear and easy to follow?	❑ Yes	❑ No
3. Did the activities meet your academic objectives?	❑ Yes	❑ No
4. Were the activities age appropriate?	❑ Yes	❑ No
5. Were the allotted times sufficient to conduct the activities?	❑ Yes	❑ No
6. Were the activities easy to use?	❑ Yes	❑ No
7. Was the preparation required acceptable for the activities?	❑ Yes	❑ No
8. Were the students interested and motivated?	❑ Yes	❑ No
9. Was the energy knowledge content age appropriate?	❑ Yes	❑ No
10. Would you teach this unit again?	❑ Yes	❑ No

Please explain any 'no' statement below.

How would you rate the unit overall?	❑ excellent	❑ good	❑ fair	❑ poor
How would your students rate the unit overall?	❑ excellent	❑ good	❑ fair	❑ poor

What would make the unit more useful to you?

Other Comments:

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8408 Kao Circle
Manassas, VA 20110
FAX: 1-800-847-1820

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