



**THIS SCHOOL
ROCKS**



NEWSPAPERS IN EDUCATION
THE OKLAHOMAN



OERB

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Artificial Lift helps a well, either chemically or mechanically, produce more fluid or gas than it would be able to by itself

Compressed Natural Gas or CNG is made by compressing natural gas to less than 1% of the volume it occupies

Drilling Rig is a steel structure that energy companies use to drill for natural gas and oil

Emissions are substances released into the air (usually by a smokestack or an automobile engine)

Erode is to wear something, such as rock, away by the action of water, wind or glacial ice

Geologist is a scientist who studies the solid and liquid matter of the Earth

Geology is the study of the Earth, the rocks of which it is made and the process by which it evolves

Igneous Rocks are formed when liquid cools and hardens

Metamorphic Rocks are formed deep below the Earth's surface under heat and pressure

Microscopic means something is too small to be seen with just your eyes

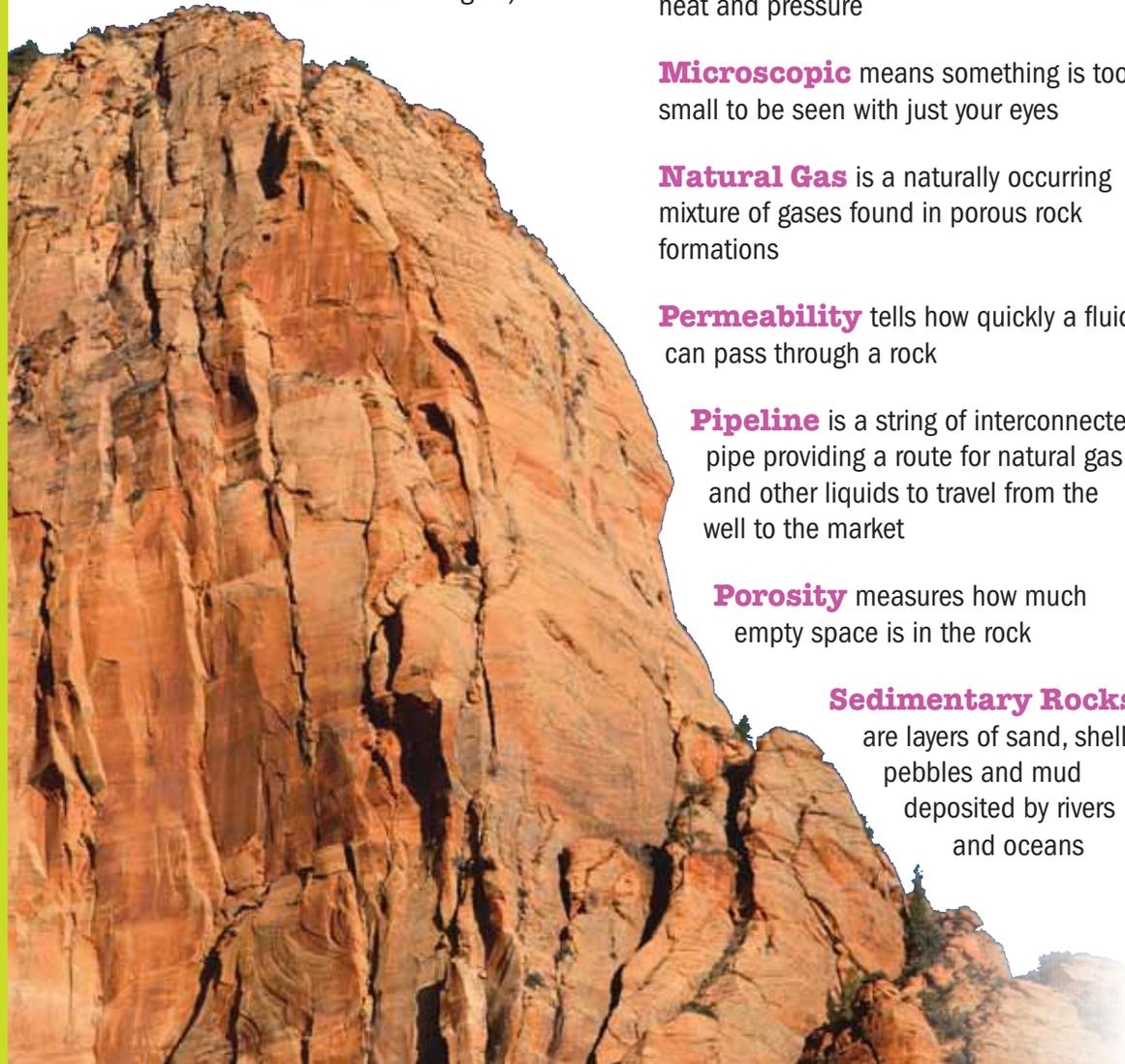
Natural Gas is a naturally occurring mixture of gases found in porous rock formations

Permeability tells how quickly a fluid can pass through a rock

Pipeline is a string of interconnected pipe providing a route for natural gas and other liquids to travel from the well to the market

Porosity measures how much empty space is in the rock

Sedimentary Rocks are layers of sand, shells, pebbles and mud deposited by rivers and oceans





A Little About Rocks

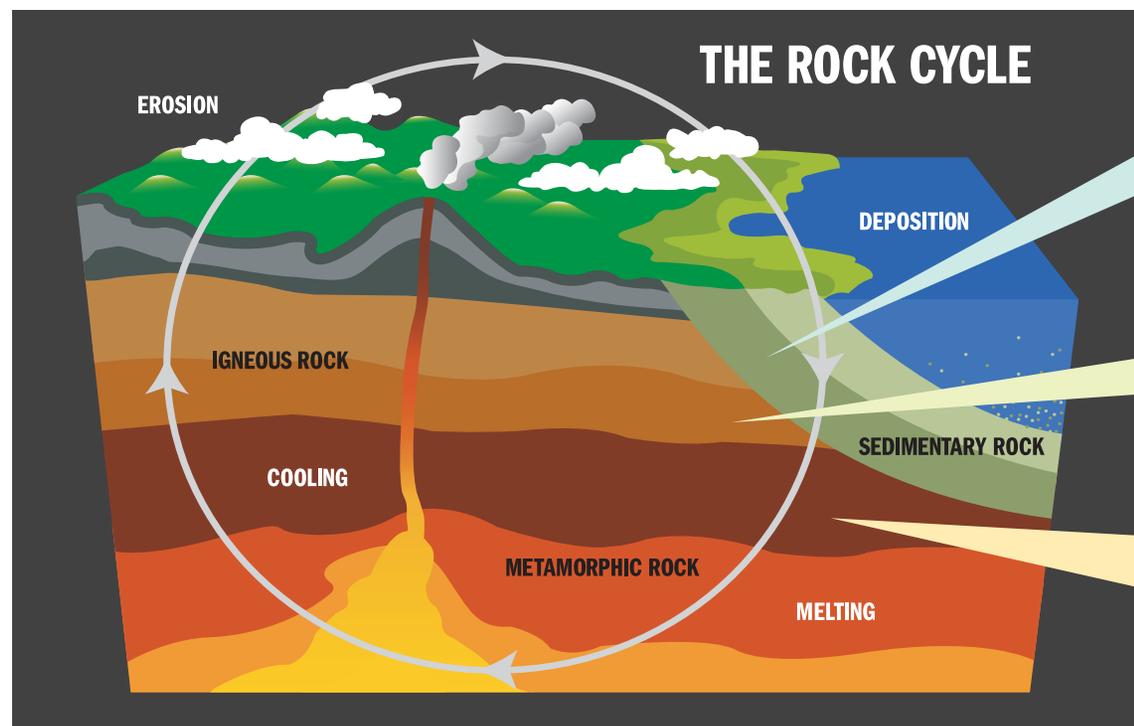
Think about all the different kinds of rocks you see when you go outside to play. Rocks come in many different shapes, sizes, colors and textures and can be found in many different places.

All of the rocks you have thought of come from one of three rock “types:”

Igneous Rocks	Metamorphic Rocks	Sedimentary Rocks
Form when molten rock cools and hardens. Depending on how quickly the liquid cools, these rocks can sometimes look like glass.	Form deep below the surface of the Earth from a combination of heat and pressure. These rocks often have layers that look like ribbons and shiny crystals.	Are made from layers of sand, shells, pebbles and mud that are deposited in rivers and oceans. You can often see the sand, stones and shell fossils in these rocks.

The Rock Cycle

When looked at together, these three types of rock create the rock cycle:



Sedimentary Rocks are formed on the ocean floor where sediments are deposited after they have been eroded.

Igneous Rocks are created when pockets of hot liquid magma are trapped and cooled.

Metamorphic Rocks form deep in the Earth where there is a lot of heat and pressure.

When learning about rocks, it's important to understand the difference between **POROSITY** and **PERMEABILITY**. By learning about these two new words, you'll be able to understand how rocks play a part in helping us get natural gas and oil for energy!

POROSITY measures how much empty space is in a rock. A rock can have many levels of porosity. If a rock has greater porosity, it has a LOT of empty space. If a rock has less porosity, it means that there is not much space at all!

Here's a fun activity to help you understand porosity

Objective: To determine which is more porous, sand or clay

What you'll need:

- Sand
- Clay
- Two glass jars or beakers
- Water

Directions:

- 1.** Feel the sand and clay. Describe how they are different. How would you describe the graininess of the sand? Notice how you can see spaces between the sand granules - this might be a clue as to which is more porous.
- 2.** Fill one jar nearly full with sand and the other with clay. Make sure each jar is filled to the same height, yet leave some space at the top of each jar.
- 3.** Fill each jar to the top with water. Watch and see where the water goes. Remember this as we learn about natural gas and oil later.



Now, let's learn more about **PERMEABILITY!**

PERMEABILITY tells us how quickly a fluid can pass through a rock. If the rock has high permeability, the liquid will move quickly. But if it has low permeability, the liquid will move much slower or not at all.

Here's a fun activity to help you understand permeability

Objective: To see what porosity and permeability look like together and to see how quickly fluids can pass through solid materials

What you'll need:

- Glass jar or vase
- Large polished stones or marbles
- Sand
- Water

Directions:

- 1.** Begin by filling the glass vase with the large polished stones or marbles. The vase represents a rock and the clear glass allows us to see inside of the "rock."
- 2.** Pour the sand into the vase. Note that the sand fills in the empty areas between the polished stones. This is because the "rock" is porous and has open spaces between the larger "grains."
- 3.** Next, see if there is enough space to pour the water into the vase. While the "rock" may look full from the outside, there are connected spaces between the small sand grains that will allow the water to travel and fill available areas in the vase.
- 4.** Pour the water in the vase to understand permeability. See how the water is able to travel because the open spaces in the "rock" are connected. You will want to remember this as we learn about natural gas and oil as well.

PERMEABILITY



Natural Gas and Oil: What Are They?

Natural gas and oil are both a part of everyday life. They are used for many different things such as heating your house, powering your car and helping make many of the “things” you use each day. In fact, natural gas and oil are used in more than 6,000 different products, and the list keeps growing!

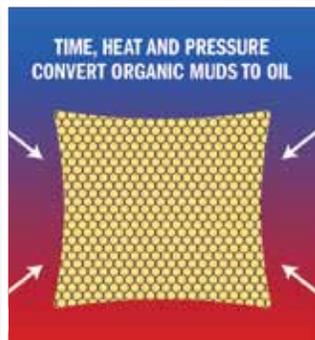
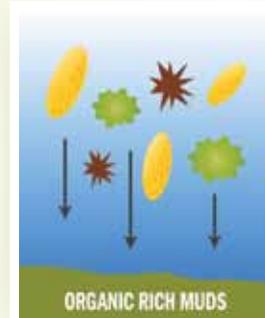
Looking at the items below, can you guess which ones were made with the help of natural gas and oil?



Natural Gas and Oil: How Are They Made?

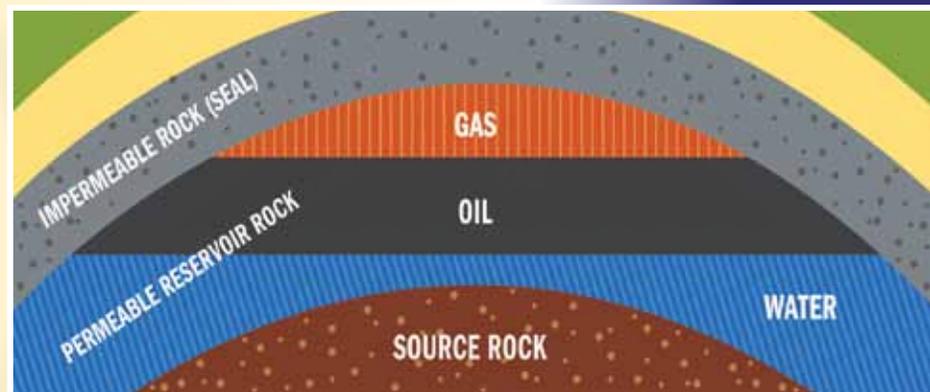
Would you believe that all of the items shown were made from natural gas or oil? Well, they were! Now, if natural gas and oil are used for so many things, where do they come from?

Most of the natural gas that we use today began as microscopic plants and animals living in oceans tens of millions of years ago. As these plants and animals grew, they absorbed energy from the sun, and that energy was stored as carbon molecules in their bodies. When these plants and animals died, they sank to the bottom of the ocean and were slowly covered by layers of sediment (like sand) over the years.



As the plants and animals became buried deeper in the Earth, the increasing heat and pressure transformed the plant and animal matter into natural gas and oil.

Since natural gas and oil are lighter than water, they began to travel up through tiny pores and cracks in the rock above until they were stopped by a dense layer of rock that would not let them through. This rock is called a cap rock or "seal" because it acts as a lid above natural gas and oil, preventing them from rising any higher. It is in these reservoir rocks, below the cap rock, that we find natural gas and oil today.



Natural Gas and Oil: How Do We Find Them?

If natural gas and oil are trapped under the cap rock, how do we get them?

First, we must look for sedimentary rocks because they have high porosity and permeability, which makes them the easiest types of rock to get the natural gas and oil out of. In these rocks, both natural gas and oil flow quicker and more freely.

To find natural gas and oil:



- Geologists map ancient rivers and beaches looking for sedimentary rocks that may hold natural gas and oil. Some of the sands that form these rocks may be millions of years old.
 - Sometimes, the geologists use reflection seismology to study rocks miles below the surface. This is when big trucks send sound waves through the Earth and computers record how long it takes for the waves to bounce back.
 - Geologists use the sound waves to tell the depth and shape of the rock formations below.
- All of this helps them better determine where natural gas and oil might exist.

When the geologists have found a spot where they think natural gas and oil exist, they then must work to get it out of the ground. To do this, they move in a drilling rig.

A drilling rig is what energy companies use to drill through rock to find the natural gas and oil.

Natural Gas and Oil: How Do We Get Them?



If a well has enough pressure in the formation to bring the natural gas and oil to the surface without help, it is “free flowing.” Often, to aid and increase the production, several forms of artificial lift are used. One type of artificial lift that you have probably seen is a pumping unit. A pumping unit is a big heavy piece of equipment that moves up and down to pump oil out of the ground. The oil then goes from the pump to a refinery where it is turned into the products you learned about on page six.

How far down do you think you might have to drill to find it?
Well, some energy companies have to drill holes that are six times deeper than the Empire State Building is tall!

Once the hole has been drilled deep down into the Earth, a “Christmas Tree” is put on the surface. A “Christmas Tree” is the arrangement of pipes and valves at the wellhead to control the flow of oil and natural gas and to prevent blowouts. The “Christmas Tree” also directs the flow of the natural gas to equipment, storage tanks and pipelines. All of the wheels and valves, which help give it the “Christmas Tree” name, are important to the functioning of this piece of equipment.



An experiment: Give natural gas some space!

Objective: To learn how natural gas can take up a lot of space and how it can be contained within a material – even if you cannot see it

What you'll need:

- Empty bottle
- Balloon
- Funnel
- Baking Soda
- Vinegar

Directions:

- 1.** Using the funnel, fill the balloon with baking soda. Be careful not to fill the neck of the balloon. It might help to slightly inflate (and then deflate) the balloon before filling it with baking soda as this will stretch the balloon and better prepare it to be filled with gas later.
- 2.** Rinse or wipe off the funnel and use it to fill the bottle one-fourth full of vinegar.
- 3.** Stretch the neck of the balloon over the bottle opening, being careful that none of the baking soda spills into the bottle. Make sure the balloon is secured on the bottle top.
- 4.** Lift the balloon quickly, allowing the baking soda to fall into the bottle. Be sure to hold the balloon – with your fingers – onto the bottle opening. As the soda reacts with the vinegar, bubbles will appear. When the bubbles pop, they release gas into the air. This gas will take up space in the bottle and eventually blow up the balloon.



Natural gas is the cleanest-burning hydrocarbon on the planet! This means that it releases less pollution into the air than other forms of energy, such as oil and coal.

In addition to being clean, natural gas is:

- **Abundant** - we have at least a 100-year supply in the U.S.
- **Affordable** - cheaper today than traditional gasoline
- **American** - produced from coast to coast - natural gas from North America provides more than 99% of our needs

There are now cars that run on compressed natural gas, and these cars produce up to **30%** less greenhouse gas emissions than cars that use traditional gasoline.

Particulates are pollutants caused from emissions. Natural gas produces the least particulates of any fossil fuel, meaning if we use more natural gas, we will have cleaner air!

Amount of particles

Produced by natural gas	7
Produced by oil	84
Produced by coal	2,744



Safety First: Staying Alert Near A Natural Gas Pipeline



Remember the “Christmas Tree” device that controls the flow of natural gas through various pipelines once it is out of the ground? Well, you must always remember that one of these pipelines could be nearby. Because you can’t see the pipelines under the ground, you often forget that they are there.

It is important to know if there is a pipeline near you!

Energy companies will always show you where pipelines are by using signs and markers above the ground.

When you see one of these, be sure you do not dig a hole in the ground until you call 811 on your phone. This number will connect you with someone who can tell you exactly where the pipeline is and where it is safe to dig.

From time to time, there are natural gas leaks. Although natural gas leaks are uncommon, it’s good to know the warning signs. The best way to spot a leak is to remember these three S’s – Sight, Smell and Sound.

- **Look** for:
 - A white cloud or fog
 - Discolored or dead plants
 - Flames coming from the ground
 - A pool of liquid
 - Continuous bubbling in a wet, flooded area or a rainbow of sheen on water
 - A slight mist of ice or frozen area on a pipeline
- **Smell** for:
 - An unusual odor or the scent of gas – natural gas in your home smells like rotten eggs or a skunk, whereas gas in a pipeline will NOT have this smell
- **Listen** for:
 - An unusual hissing or roaring noise coming from a pipeline

If you think there’s a leak near you:

1. Leave the area
2. Tell an adult
3. Call 911 from somewhere safe

Know what’s at stake™
Call 811
BEFORE YOU DIG



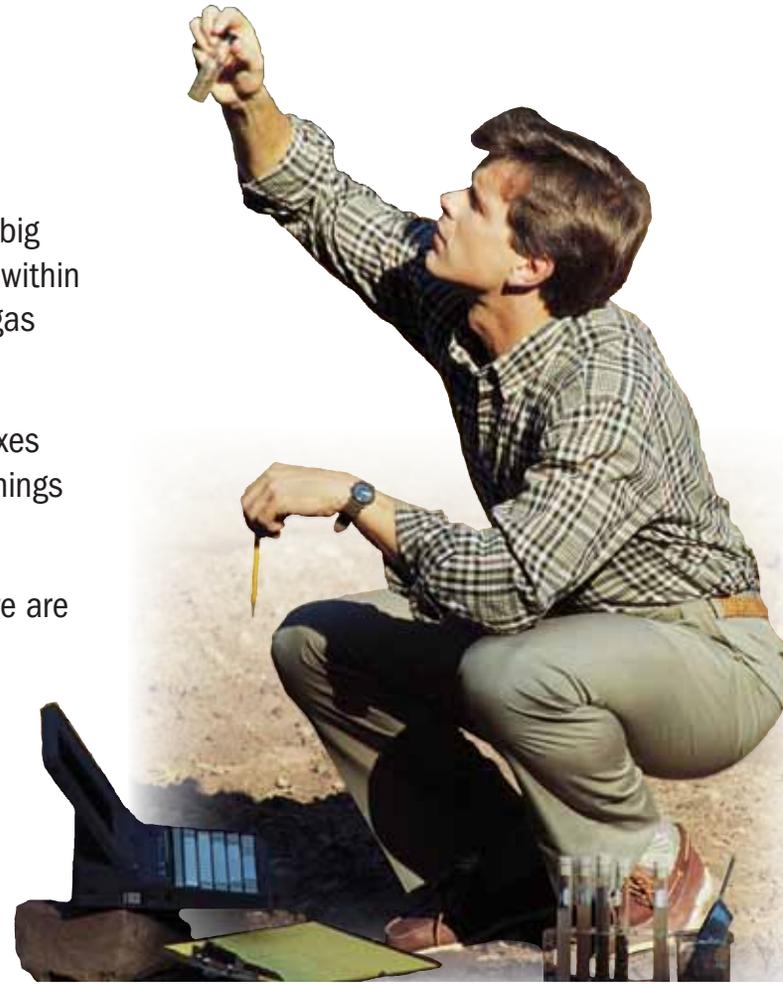
Learning more about the Natural Gas and Oil Industry

The gas and oil industry is important to Oklahoma, but it is also making a big impact all over America! Today, more than 9.2 million people work in jobs within the industry, and more than \$1 trillion is being added to our economy by gas and oil companies.

Because these companies make so much money, they also pay a lot of taxes each year. The money raised through these taxes is then used to pay for things like schools and roads throughout your community.

With more than 9.2 million people working in the gas and oil industry, there are many different types of jobs a person can have. Here are just a few:

- **Science**
- **Engineering**
- **Accounting**
- **Energy management**
- **Media**
- **Geology**
- **Business management**
- **Politics**
- **Marketing**
- **Information technology and more!**



Due to Oklahoma's natural gas reserves, there are many local jobs within the natural gas and oil industry.

The average income for workers in the natural gas and oil industry is \$107,000 a year.



Here is what some current natural gas and oil employees have to say about their jobs:

"I always wanted to pursue a profession that would captivate my interest and be financially rewarding. I have worked as a petroleum geologist for over 30 years and have enjoyed the diversity and challenges of my job. The rewards have been very satisfying from both a geoscience and financial perspective. I can't imagine a better career choice."

Keith Rasmussen, Sr. Geologist

"As a student of history, I always understood the role that energy plays on the world stage. I also knew that the natural gas and oil industries would play an especially important role in my lifetime here in the United States as we seek to continue to decrease our dependence on foreign oil. This industry provides great opportunities for those willing to work hard alongside great people while serving our local economy in Oklahoma and meeting the challenges we face as a nation in regards to energy."

Jordan Brandenburg, Landman

"For me, the best thing about being in the energy industry is that every day there are new challenges to face, new problems to solve and new technology to investigate. It is fast paced and interactive. Overall, the energy industry is simply intriguing because there should never be a way to be bored."

Mary Bruce, Production Engineer





INVESTING IN EDUCATION FOR THE FUTURE OF OKLAHOMA

As one of the nation's leading natural gas and oil producers, Chesapeake Energy Corporation is Fueling America's Future® in education. We're supporting organizations like Smart Start Central Oklahoma, which is enabling 10,000 children to enter school ready to read, learn and excel. And we're proud sponsors of the Oklahoma Foundation for Excellence, The Foundation for Oklahoma City Public Schools, Boy Scouts of America – Last Frontier Council, Girl Scouts – Western Oklahoma, Inc. and much more. We're committed to education and to making sure the next generation of Oklahomans enjoys the brightest future possible.



AMERICA'S CHAMPION OF NATURAL GAS®