

## Your Natural Gas Activity Booklet Teacher's Guide

### Introduction

*Your Natural Gas Activity Booklet* uses engaging puzzles and activities to explain natural gas science concepts and describe how to safely use natural gas in daily life. This guide provides background and discussion ideas on the science, safety, and efficient use of natural gas and includes activities for related natural gas lessons and answers to the booklet's puzzles.

### Lesson 1: What Is Natural Gas and How Is it Formed?

Natural gas is a fossil fuel that can be used for heating air and water, cooking, and producing electricity. It is colorless, odorless, and lighter than air. Natural gas is composed mainly of methane (CH<sub>4</sub>). When ancient plants and animals were buried under swamps, lakes, or mud, they decayed, slowly forming methane gas. This "traditional" natural gas became trapped under layers of solid rock, and today it is found underground in the same areas that contain crude oil, also known as petroleum.

About 3,000 years ago, ancient peoples found burning springs of natural gas and built temples around these "eternal flames." It wasn't until about 2,500 years ago that the Chinese realized these springs could be used. The Chinese used bamboo poles to pipe the natural gas. This natural gas was used to evaporate seawater, leaving behind valuable sea salt.

Today, a newer type of natural gas called renewable natural gas, or RNG, can be made from organic waste materials such as garden and lawn clippings, food scraps, and cow manure. These materials are collected in a "digester" tank where they decompose, creating methane and other gases. Once the methane gas is collected, cleaned, and conditioned, it can be added into the utility natural gas distribution system and used as an energy source for homes, businesses, and factories. It can also be used as a transportation fuel.

### Discussion:

1. What gas do we need to live? (*The air we need to breathe is a mixture of gases. Air consists of nitrogen, oxygen, argon, carbon dioxide, hydrogen, and small quantities of neon, helium, and other inert gases.*)
2. What is meant by the term "natural"? (*Found in nature and not made by people.*)
3. A few thousand years ago, people discovered burning springs of natural gas. How do you think these springs were naturally ignited (lit)? (*Lightning.*)
4. Like coal and oil, traditional natural gas is a fossil fuel. Why is it called a "fossil fuel"? (*It is formed from the remains of fossilized plants and animals.*)

### Activities:

- Blow up a balloon. Ask students what is in the balloon. What other gases do you know about? What is gas? (*Gas is a form of matter that is not solid or liquid. Gas can move and does not have a definite shape.*)
- To understand how natural gas is found deep underground, have students make clay models of the rock layers in the earth. Rock layers can be different thicknesses and shapes. Use red clay for natural gas and green clay for oil. When finished, punch a hole down to the natural gas and oil layers. (*Students may have to research the various layers found in the earth.*)
- Research through a natural history museum, library, or local college what rock layers lie under your town, and then construct cross-sections out of clay.

- Fill several small-necked glass jars (8 oz.) with a mixture of 1/4 cup of soil and 1/3 cup of vegetable scraps (carrot and cucumber peels) and grass clippings. Stretch a balloon over the opening of each jar and secure it well. With a magic marker, mark the level of the mixture that you start with. Place the jars in different places (direct sunlight, artificial light, in a dark place, etc.). Observe the jars for a week. Chart the results, both the level of each mixture and what happens to each balloon. (Depending on the contents of the mixture and the amount of heat in each location, mixtures will decompose at different rates and produce different amounts of gas.)

## **Lesson 2: Where Is Traditional Natural Gas Found and How Is it Distributed?**

Geologists (scientists who study the earth) send shock waves down from the surface in order to try to locate traditional natural gas deposits. They measure how long it takes the waves to bounce back. A derrick is constructed to support the equipment needed for drilling the well and for hoisting and lowering pipe into it. In some offshore locations, drilling platforms are used to obtain gas.

When traditional natural gas is found, it is pumped from the well to a processing plant where other substances found with the gas are removed. After processing, it goes through underground steel pipelines with the aid of compressors. Compressors are large pumps that push the gas through the pipelines at about 15 m.p.h.

Before reaching us, the gas passes through a regulator station that controls the amount of gas pumped into the smaller pipes that lead to our homes, businesses, and factories. At this point, a chemical (mercaptan) that can smell like rotten eggs is added to the gas so leaks can be detected.

### Math Problem:

If you dug a 5,000-foot well and you had to spend \$100 per foot, how much would it cost? (*\$500,000.*)

### Discussion:

1. How do you think traditional natural gas is obtained from below the surface of the earth? (*Wells.*)
2. How is gas sent from where it is found or made to homes, schools, and businesses? (*Through underground pipes.*)
3. What pipes or wires can be found underground? (*Water mains, electrical wires, natural gas pipelines, telephone lines, etc.*)

### Activities:

Fill an aquarium half full of water. Blow up a balloon and hold the opening closed as you submerge the balloon in water. Relate this to natural gas trapped beneath impermeable rock (like clay). Discuss what would happen if you drilled a hole to where the natural gas was trapped. Let air out of balloon under water.

### **811 Safety Tip:**

Explain to students that natural gas comes to our homes and schools through pipelines that run under streets, sidewalks, yards, and homes. If people dig into these pipelines, they can be damaged and natural gas can leak out. Even a small leak can cause a fire or possibly even an explosion. Protecting underground lines from damage is everyone's job, so we all need to take care not to damage underground gas pipes with digging equipment.

Remind students that if their family is planning a digging project, they must call the 811 utility locator service by dialing 8-1-1 several days ahead of time so underground utilities can be marked for safety. The 811 service arranges for the location of gas pipelines and other buried utilities to be clearly marked so people can dig a safe distance away from them.

Ask for examples of types of digging projects that would warrant a call to the 811 service. (*Planting a tree or garden, grading a driveway, installing a sprinkler system, or building a home, an addition to a home, or a fence.*)

Explain to students that after the 811 service receives a request to have underground utilities marked, a worker comes to the site and uses either colored spray paint or flags to indicate the location of buried utility lines. Natural gas lines are marked in yellow. Remind students that they should never tamper with utility flags or markings, as they are put there to prevent damage to underground utility lines and to keep people safe.

### **Lesson 3: How Can Natural Gas Be Used?**

Natural gas can be used in homes, schools, businesses, and factories for heating, cooling, clothes drying, cooking, and providing hot water. Natural gas can provide heating and cooling for stores and offices and can be used for cooking in restaurants. Industry uses natural gas as a fuel, and transforms it chemically into plastics, fabrics, and durable goods. Natural gas can also be used to generate electricity.

#### Discussion:

1. What equipment in a restaurant would use natural gas? (*Water heater, fryers, range/oven, steamer, grill.*)
2. How would natural gas be used in offices and stores? (*For heating air and water.*)
3. What are some other possible appliances, processes, or systems that run on natural gas? (*Heating and cooling, clothes dryers, fireplaces, barbecues, manufacturing, etc.*)

#### Activities:

- Survey your home to determine which appliances, if any, run on natural gas. (*Answers could include natural gas furnace, barbecue, range, water heater, dryer, fireplace, swimming pool heater, and/or outdoor lighting.*)
- With the help of an adult, locate where gas lines lead to and from appliances such as water heater, furnace, and stove. Notice how the vents are connected.

### **Lesson 4: How Can You Be Safe Around Natural Gas?**

Natural gas is a safe fuel when used properly. To burn, gas must mix with the proper amount of air and be ignited by a flame or spark. Ranges and other appliances are carefully adjusted to provide the correct air-gas mixture. Burning natural gas without enough air produces carbon monoxide, a deadly poison. Your household should have your gas-burning equipment, home insulation, and ventilation checked to make sure your home is safe and fuel-efficient. All gas appliances must be correctly installed, maintained, and vented to the outside. Furnaces and chimneys must be inspected regularly by qualified service people.

Stress with your students that homes should not be heated with gas ovens. Tell them that there is a risk of fire and explosion from gas leaks. That is why when you smell gas, you should leave the house. Do not turn a light on or off; unplug an appliance; or use a flashlight, match, or telephone, because a spark from any of these could cause an explosion. Make sure children know that they should call for help from a neighbor's house. (It should be a neighbor that they know.) Keep the area around furnaces and water heaters clean and free from litter.

#### Discussion:

1. What senses do you have? (*Sight, hearing, smell, taste, touch.*)
2. How can you use your sense of smell to detect a natural gas leak? (*Natural gas has a chemical [mercaptan] added to it that can smell like sulfur or rotten eggs. When gas is leaking, this odor is typically present. If you smell this odor in your home, tell an adult and leave immediately.*)
3. What other senses can you use to detect a natural gas leak? (*You may SEE grass/plants dead or dying for no apparent reason. You may HEAR a hissing, whistling, or roaring sound. You may SEE or HEAR continuous bubbling in water, or dirt spraying or blowing into the air.*)
4. Why is it dangerous to hang from gas pipes? (*Pipes could break and gas would leak out.*)

Activities:

- Do a natural gas leak drill in the classroom. When you return, or while outside, discuss why you have these rules and drills.
- As a class, create mini safety charts to list natural gas safety rules.
- At home, practice a safety drill for getting your family out of the house safely. (Stress not to turn on lights, and not to use flashlights, matches, or telephones.)

**PUZZLE ANSWERS**

Page 3: 1. liquid; 2. gas; 3. solid; 4. solid; 5. liquid; 6. gas

Page 4: Natural Gas Deposits Are Below The Surface Of The Earth

Page 5:  $5 \times 5 = 25$     $4 \times 3 = 12$     $25 + 12 = 37$  total miles drilled

Bonus: There are **3 million miles** of natural gas pipeline in the US.

Page 6: 1. North America; 2. South America; 3. Africa; 4. Europe; 5. Asia; 6. Australia

Page 7: Gas; Fuel; School Bus.

Pages 8-9: **Section 1 – Home**; natural gas symbol on hot water heater, furnace, clothes dryer, oven, bedroom heater, outdoor barbecue, outdoor light. **Section 2 – Business**; natural gas symbol on bus, pizza oven, office heating vent; **Section 3 – Factory**; natural gas symbol on heater/ventilators hanging from ceiling.

Page 10: 1-basement; 2-bus; 3-heat the offices, run the bus, cook pizza; 4-bats; 5-bedroom, kitchen, basement

Page 11: Keep papers and toys away from appliances. Never play near equipment.

Page 12: It is **important** to **conserve** natural gas by not turning the **heat** too **high**.

Page 13: A **smelly** chemical is added to natural gas so you can tell if it is leaking. (It smells like sulfur or rotten eggs.) It is necessary to add an odor so that people will notice if natural gas is leaking, since it is invisible!

Page 14: Senses; blue; odor.

Page 15: The numbers in each box should be: Top Left: 3; Top Right: 4; Bottom Left: 2; Bottom Right: 1

Page 16: 1. bus; 2. underground; 3. energy; 4. appliance; 5. gas; 6. natural.

U N D E R G R O U N D  
T A N A N N K F J X Y  
B T U C L E A N E R D  
N U W S H I R A R J N  
A R S E A L Z G R A E  
R A F K L I A G Y B W  
G L A P P L I A N C E