



# Natural Gas: Your Invisible Friend

## Teacher's Guide

### Introduction

*Natural Gas: Your Invisible Friend* uses articles and activities to explain natural gas science concepts and describe how to safely use natural gas in daily life. The content addresses many state and national standards for grades 3-6, including the national health and science standards listed below:

- National Health Education Standards (reducing health risks through injury prevention)
- National Science Education Standards (properties of objects and materials)
- National Geography Standards (processes that produce forms of energy)
- National Energy Education Development (NEED) Program Guidelines for Energy Education (natural gas knowledge)

This teacher's guide provides the objective for each page of the booklet, background information, and ideas for classroom discussion and follow-up activities. Activity and puzzle answers appear on the back page of the booklet. Activities require only the materials listed in the booklet—most require only a pencil and the booklet itself. All other materials are everyday items already on hand in most homes and classrooms.

### Page 2: Natural Gas: Your Invisible Friend

Objective: Describe the characteristics of natural gas; list ways natural gas is used as an energy source.

Background: Natural gas is a colorless, odorless gas that is lighter than air. It accounts for about 25 percent of all energy used in the United States. We use natural gas in appliances (such as clothes dryers, stoves and ovens, furnaces, air conditioners, water heaters, outdoor gas lights, pool or spa heaters, barbecue grills, and fireplace logs), and in motor vehicles.

Discussion: Explain to students that a fuel is a material that can be burned to produce heat or power. Ask: What other kinds of fuels can you think of? (*Wood, gasoline, kerosene, coal*) What does natural gas look like? (*It's invisible.*) Have students read the Going Further paragraph before completing the missing vowels activity.

Going Further: Supply students with old magazines and catalogs to cut up for their collages, along with scissors, glue or tape, and butcher paper or poster board. Alternatively, students can make their own original drawings of uses for natural gas and create a class collage by pinning their drawings on the classroom bulletin board. Have students label each use they depict in their collages.

### Page 3: Energy in Your Life

Objective: Define energy; list examples of energy being used to do work.

Background: Energy is the ability to change or move matter. Without energy there would be no motion, no light, and no heat, and life would not exist. Most of the energy on earth comes from the sun.

Ask students where they get their energy. (*Food*) Ask them where the appliances in their homes get energy. (*Sources like electricity or natural gas.*)

Discussion: Ask students to list common activities that require energy. Ask them to identify activities that require only the energy from the food they eat. (*Reading, doing homework, walking, bike riding, etc.*) Then ask them to distinguish between those types of activities and activities that require other sources of energy. (*Taking a shower requires energy to heat the water; using appliances or electronic devices like the TV, computers, and clothes dryers requires energy sources like electricity or natural gas.*)

Activity: Have students create bar graphs. List activities on the *x*-axis and time on the *y*-axis. (*Sample activities: walking, riding a bicycle, playing a game, doing homework, taking a shower, cooking food, drying clothing, watching TV.*)

Going Further: Student stories should indicate that without energy, there could be no motion or growth.

#### **Page 4: Fossil Fire**

Objective: Explain how natural gas and other fossil fuels are formed; demonstrate the decay of organic materials.

Background/Discussion: Natural gas is primarily methane gas that forms when organic material (bodies of plants, animals, and other organisms) decomposes under pressure. Ask students to name the three kinds of fossil fuels. (*Natural gas, crude oil [petroleum], coal*) Ask: Why are they called fossil fuels? (*Because they formed from organisms that lived millions of years ago*)

Going Further: Students can bury organic (plant food waste) and nonorganic (plastic, metal) materials in soil placed in a large jar or plastic bin, or in an outdoor compost pile. Have students record observations of these materials at 2- to 3-day intervals over a week or two. They will observe decay of the organic materials.

#### **Page 5: Trapped in Rock**

Objective: Define new vocabulary; explain where natural gas is found in the earth.

Background/Discussion: Methane gas formed when ancient organisms decomposed and the gas was trapped under layers of solid rock. Today, it is found in the same underground areas where crude oil (petroleum) is found. Wells are drilled through the rock to bring natural gas to the earth's surface. The gas is pumped to a processing plant where it is cleaned and then pumped through pipelines to power plants, factories, businesses, and homes.

Follow-up: Have students use index cards to make flash cards with a vocabulary term on one side and its definition on the other. Students can use the cards to quiz each other on the new vocabulary on this page.

#### **Page 6: Pump It Up**

Objective: Identify states on a map of the United States; calculate the answer to an arithmetic word problem.

Background/Discussion: Explain that the map shows states with large natural gas deposits in blue. States with a blue flame have some natural gas deposits. Ask: Which of the blue areas is not a state? (*Gulf of Mexico*)

Gas Math: Subtract 1821 from the current year.

Follow-up: On the board, write other large numbers using words and have students write them using digits.

#### **Page 7: Color It a Clean Blue**

Objective: Recognize gas leaks; explain how to stay safe if a gas leak is detected.

Background/Discussion: Natural gas is a safe fuel when used properly. To burn, natural gas must mix with the proper amount of oxygen and be ignited by a flame or spark. Burning natural gas without the proper amount of oxygen produces carbon monoxide, a deadly poison. When natural gas leaks, there is a risk of fire and explosion, and there is danger of fire if combustibles are stored or used too near gas appliances.

Ask: Have you ever smelled leaking gas? What did it smell like? (*Responses will vary.*) Explain that a chemical called mercaptan is added to natural gas to make it smell like rotten eggs. Ask: Why do we want natural gas to smell bad? (*So we know when it's leaking and can protect ourselves.*)

Follow-up: Have students create posters showing safe and unsafe things to do if they smell a gas leak.

### **Page 8: Natural Gas Power**

Objective: List uses of natural gas.

Background/Discussion: Natural gas is burned in electric power plants to heat water to create steam. The steam is used to turn the turbines of generators that produce electricity. In the 1970s and 1980s, most electric power plants were fueled by coal or nuclear power. Due to environmental concerns, by the 1990s, about 60 percent of new electric power plant capacity was fueled by natural gas. Today, natural gas is the primary energy source for powering new electricity generating plants in the U.S.

Going Further: Have students find out what percentage of their electricity supply is generated by natural gas.

### **Page 9: NGVs Get Us There!**

Objective: Calculate answers to arithmetic problems; identify the advantages of natural gas as a vehicle fuel.

Background/Discussion: Natural gas contains less carbon per unit of energy, so it produces less carbon dioxide—a greenhouse gas—than other fuels. NGVs produce much lower exhaust emissions than gasoline-powered vehicles, because natural gas is a cleaner burning fuel.

### **Page 10: Home Sweet Home**

Objective: Gather data on natural gas use in the home.

Background/Discussion: Ask students to speculate about some of the ways their school might be using natural gas. Ask the building custodian or other staff to tell students how natural gas is used in their school.

Going Further: Have students share their findings about natural gas use at home. On the board, compile a list of all the reasons people gave for preferring various fuels, including natural gas.

### **Page 11: Natural Gas Is Great**

Objective: Identify uses for natural gas in the workplace.

Background/Discussion: Burning natural gas produces fewer air pollutants than the burning of other kinds of fuel—it produces no smoke when burned. It also gives off more heat per unit of energy than other fuels, so it is more efficient. Since gas is piped underground, service is not usually interrupted during storms, unlike electricity service provided by overhead power lines.

### **Page 12: Lighter Than Air**

Objective: Describe the characteristics of solids, liquids, and gases; experiment with the behavior of a gas.

Background/Discussion: Ask: What is matter? (*Anything that takes up space or has a mass of any kind. Everything you can touch is made of matter.*) A solid has a definite shape and volume. A liquid has a definite volume, but takes the shape of its container. A gas can change its shape and volume.

Activities: Use the behavior of the balloon as an analogy for the way gas molecules behave—the balloon moves freely, bouncing off the surfaces of its container (the room). Use several balloons to show how gas molecules bounce off each other.

Going Further: Natural gas can be safer to use than gasoline because if a fuel line breaks, natural gas disperses into the air rather than pooling on the ground the way gasoline does; therefore, it is less likely to catch fire. Natural gas also has a much higher ignition temperature than gasoline.

### **Page 13: Smart Gas Use**

Objective: Define conservation; identify ways to conserve energy.

Background/Discussion: Remind students that whenever we burn a fuel, even a clean-burning fuel like natural gas, carbon dioxide and other gases are released into the air. Carbon dioxide is a greenhouse gas; some of the other gases released when fuels are burned (e.g., carbon monoxide, nitrogen oxides) are air pollutants. Natural gas is a nonrenewable resource. If natural gas production continues throughout the world at the level it did in 2003, the world's gas reserves are expected to last about 67 years. (Source: BP Statistical Review of World Energy 2004)

Going Further: Possible energy-saving ideas: Set the flame just high enough to cover the pot bottom—it saves energy and is safer than a higher flame. Cover pots when cooking. Use a clothesline instead of the dryer. Wash full loads of dishes and laundry. Clean out the dryer lint filter before each load to improve airflow and reduce fire risk. Set the heating thermostat to 68° F by day and 55° F by night. Close window coverings at night to retain indoor heat. Close doors quickly when you enter or leave a house where heat is on. Ask an adult to change heating filters at the start of each heating season.

### **Page 14: Safety First**

Objective: Recognize important gas safety practices; explain what to do if the smell of gas is detected.

Background/Discussion: Why is it so dangerous to store flammable objects near gas appliances? (Gas appliances use a flame and some, like an oven or heater, can get hot enough to set fire to something flammable that is close by. Also, the fumes of flammable liquids could be ignited by the flame or pilot light inside a gas appliance.) What does it mean if your gas range has a large, yellow, or flickering flame? (It is not working properly and you should call a repairperson.) Why shouldn't you let small children play with gas appliances? (They could turn the gas on by mistake, or damage the pipes and cause a gas leak.) Natural gas travels in underground pipes. Remind students that if their family is planning a digging project, they must call the utility locator service so underground utilities can be marked for safety.

### **Page 15: Smell, Leave, and Tell**

Objective: Recognize the signs of a gas leak; explain how to stay safe in the event of a gas leak.

Background/Discussion: Ask: Why should you tell an adult when you smell gas? (*There is danger of fire or explosion.*) If you smell gas when no one is home, what do you do? (*Leave and take everyone with you. Don't use electricity or fire. Go to a trusted neighbor's and call 911 and the local utility.*) What should you do if you find signs of a gas pipeline leak? (*Do not use electricity or fire. Get far away from the area and don't go back until safety officials say it's safe. Ask a trusted adult to report the leak to 911 and the local gas utility.*)

Going Further: Any of these actions could cause a spark or flame that would ignite leaking natural gas.