PPL companies

Natural Gas Safety World
Teacher's Guide

Introduction
Natural Gas Safety World uses articles, experiments, and activities to explain natural gas science concepts, and how to use this fuel safely in daily life. The content addresses the relevant National Science Education Standards (NSES) and Health Education Standards (HES) for grades 4-6. This presentation guide provides the objective for each page spread, background and ideas for classroom discussion, activity and puzzle answers, suggestions for experiment setup and completion, and follow-up activities. Activities can be done with materials listed in the booklet.

Page 2: Introduction to Energy Use
Objective: To make students aware of how they use energy (e.g., for light, heat, etc.) and the sources of energy they use (e.g., electricity, natural gas, etc.).

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

Energy Use Chart: Help students complete the energy use chart. Ask them to consider whether they did any of the following things the previous day: took a bath or shower, cooked food, watched a TV show or video, listened to music, were driven to school, enjoyed a warm or cool home, played a computer game. Ask students what appliance or equipment they used to do each thing. Have them record their answers in the first and second columns. If students are not aware of the energy sources that run the appliances and equipment they used, ask them to check with their families and fill out the third column at home. *(Tips for recognizing energy sources: Appliances and equipment that use natural gas or other fuels have a flame inside when they are on. Electrical appliances plug into a wall outlet, and portable electric devices run on batteries.)*

What Do You Think? Students' answers will vary. Depending on your climate and season, keeping warm or cool without using energy may require a lot of ingenuity. Students may find it interesting to speculate about—or do some research on—how people native to your area kept warm or cool before the invention of modern heating and air conditioning systems.

Follow-up: Have students complete a day's energy diary showing all the sources of energy they use from the time they get up until they go to sleep.

Page 3: Energy Vocabulary
Objective: To familiarize students with some new concepts and vocabulary regarding natural gas.

Background/Discussion: Review the vocabulary words in the word search. Preview the book by asking students to find the first time each of these words is used. *(Appliance–p .2; Energy–p. 2; Fossil Fuels–p. 4; Gas–p. 4; Gas Meter–p. 6; Odorant–p. 6; Natural Gas–p. 2; Service Lines–p. 6; Utility–p. 6; Well–p. 6.)*

Have students write a paragraph using some of these words.

Word Search Key:

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

Page 4: The Three States of Matter
Objective: To help students understand the characteristics of solids, liquids, and gases.

Background/Discussion: What is matter? *(Anything that takes up space or has mass of any kind. Everything you can touch is made of matter. If it is made of anything, it is matter.)* There are actually four states of matter. The fourth state, not discussed on this page, is plasma—a gas made up of free-floating ions.

Answer Key: Top box: Gas Middle box: Liquid Bottom box: Solid

What Do You Think? *Oil is a liquid. Natural gas is a gas. Coal is a solid.*

Follow-up: You can show how three states of matter exist at once in a burning candle. **(This experiment should only be done under a teacher or other adult's supervision.)**

1. Ask an adult to light a candle. Let the candle burn for a minute.
2. Which part of the candle is solid? Which part is liquid? *(The wax is solid. The melted wax is liquid.)*
3. Is any part of the candle a gas? To find out, have an adult light a match, then blow out the candle and quickly move the lit match to about $^1/_2$″ above the wick. The match should light the candle without touching the wick. If it does not, repeat steps 1 and 2.
4. What happened? *(The first flame heated the candle wax, turning it to a liquid. As the candle burned, the liquid wax heated up even more and turned into a gas. The gas rose up the wick and into the air. The second flame from the match ignited the gas.)*

Energy Conservation: Ask students for suggestions as to ways they can use energy wisely and in moderation. *(Laundry: dry clothes outside when the weather allows. Transportation: ride a bike or walk instead of driving, if possible. Household: turn out lights when leaving a room. Hot water: turn down the setting on the household water heater to "warm.")*

Page 5: Density Experiment
Objective: To promote students' understanding of the concept of density, and of the differences in density between gas, water, and oil. Clearly discuss the definition of density before proceeding with the experiment. *(Density is a measure of how many molecules there are—and therefore how close together they are—in a certain amount of a substance. You might also discuss this concept in terms of people in a room: the more people there are, the more densely they inhabit the space.)*

Background/Discussion: Before conducting the experiment, encourage students to predict what will happen when the oil and water are poured into the bottle. This familiarizes them with the process of forming a hypothesis.

Experiment Results: The experiment will demonstrate that water is the most dense (it stays at the bottom), oil is the next dense (it floats above the water), and air is the least dense (it stays at the top). Encourage students to make conclusions about why the oil rests above the water, and both oil and water are beneath the empty space (air). Student answers may vary, but make sure they understand that air has the least amount of molecules and thus rises to the top, whereas water has the most molecules and stays at the bottom.

Diagram Labeling: *Natural gas is on top, then oil, then water at the bottom.*

Follow-up Discussion: After students have completed the exercise of labeling the diagram, ask them to apply what they learned in the experiment to their conclusions about how gas, oil, and water rest underground. They should understand that in this case, gas is similar to air in that it is the substance with the fewest molecules as compared to the oil and water, and thus it rests above these two substances underground.

Page 6: All Those Pipes!
Objective: To familiarize students with the natural gas distribution system so they understand how gas gets from the well to their homes.

Background/Discussion: To help students become aware of the importance of natural gas in our lives, ask students which appliances in their home use natural gas. *(Answers could include water heaters, stove burners, oven, washer, and dryer.)* Explain that because natural gas travels in underground pipes, natural gas service can't be interrupted by storms, but people 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 local one-call utility locator service at 811 so underground utilities can be marked for safety. Ask for examples of types of digging projects that would warrant a call to the one-call 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.)*

Answer Key: *1–well. 2–processing plant. 3–transmission pipes. 4–compressor station. 5–storage tanks. 6–utility. 7–distribution main. 8–service lines. 9–gas meter. 10–appliances.*

Page 7: Natural Gas Safety Tips
Objective: To teach students important gas safety practices, and what to do if they smell gas.

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 them on by mistake or damage the pipes and cause a gas leak.)* What are some signs of a gas pipeline leak? *(A smell of sulfur or rotten eggs; a hissing sound; dirt being blown into the air;*

continual bubbling in a pond, river, or creek; grass or plants that seem to be dead or dying for no reason.) If you smell gas when no adults are home, what do you do? *(Get everyone out of the house and go to a safe location to call the local natural gas utility. Don't use anything electrical or light a match—a spark could ignite the gas..)*

Back Cover
Objective: To encourage students to discuss natural gas safety with their families.

Background/Discussion: Why should you carry out a home safety inspection? *(You might find something hazardous in your home that could be fixed.)*

Explain each of the hazards in this list. Ask students if they can explain why it is a hazard. *(1. Small children playing near the range or other natural gas appliances is dangerous. They could accidentally ignite a fire or turn the gas on by mistake. 2. People digging without first having called 811 could dig into the natural gas pipeline, causing the gas to leak out and become a fire hazard. 3. Laundry hung to dry on gas or water pipes could loosen pipe connections and cause a gas leak. 4. A yellow flame on a gas range should be checked by a qualified repairperson, as it could indicate a gas leak and be a fire hazard. 5. Natural gas ovens are designed to cook food, not to heat rooms. Using your oven to heat the kitchen could damage the oven and produce gases that are dangerous to breathe such as carbon monoxide. 6. If chimney flues and appliance vents get clogged, the result could be a fire hazard, health risks from dangerous fumes, and/or damage to appliances. 7. Papers, clothing, curtains, and flammable liquids stored near open flames or heaters could catch fire.)*

Homework: Ask students to take this inspection checklist home and to do the inspection with their families. Ask students to report what natural gas hazards, if any, they found in their homes and whether/how their family fixed the hazard.

Follow-up Discussion: Can you think of any other items you could add to this safety inspection checklist?