Energy
Education World

nationalgrid

Natural Gas Safety and Science

Smell Gas. Act Fast.

This booklet helps you learn about natural gas and how you, your friends and your family can use it safely and properly.

Energetic life

You need **energy** to move, play and work, and you get your energy from food. Appliances like ovens, dryers and water heaters need energy to work too. Some appliances get their energy from **natural gas**, an energy source that comes from deep underground and is delivered to buildings through pipelines.

What do you already know about natural gas safety?

1. On a sheet of paper, write what you already know about using natural gas safely in your home.
2. Next, search online or ask a chatbot for a list of natural gas safety tips for students your age. (Work with an adult on this.)
3. Use a different color to add any new tips to your written list.
4. As you work through this booklet, use a third color to add any new tips you learn to your list.
5. Save your full list for the "Putting it All Together" activity on page 15.

Word hunt fun

Find definitions for the following natural gas vocabulary words, using this booklet or a dictionary. These words are highlighted in red where they first appear.

- energy
- natural gas
- natural resources
- porous
- fossil fuel
- wells
- pipelines
- utility
- mercaptan
- sulfur
- ventilating
- carbon monoxide
- vents
- gas meters

800-428-5837
Product #38645 Run #5084 August 2024
Printed by Quad/Graphics, West Allis, WI

Chart your energy use

1. List five different activities you did this week that involved an energy-using tool, appliance (such as a range or dishwasher) or a piece of equipment (such as a water heater or furnace).
2. Write on the chart the item you used for each activity.
3. Estimate the amount of time you spent on each activity. Use 15-minute increments and convert them to decimals to fill in the chart.

KEY

15 minutes = .25
30 minutes = .50
60 minutes = 1.0

4. Add up the time you spent and write the total on the chart.

Bonus: Graph your results.

MY ACTIVITY	ITEM USED	TIME SPENT
	TOTAL TIME	

Natural gas safety is a shared responsibility!

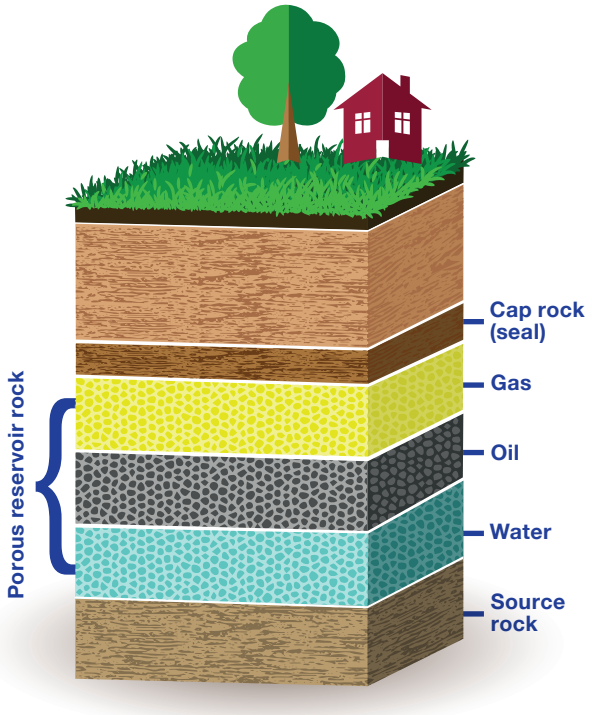
This booklet explains many ways that you and your family can be safer around natural gas in your home. To ensure natural gas comes to your home safely, your **utility**:

- Monitors the gas pipeline system for leaks 24 hours a day, seven days a week.
- Continually tests, inspects and repairs their natural gas pipelines.
- Educates people about digging safely near gas pipelines.

Go underground

Natural gas is usually* found along with oil and water several thousand feet below the earth's surface, in underground layers known as reservoir rock. In order for gas to be present, there must be a source rock that produced the gas, a **porous** rock that holds the gas and an overlying bed of cap rock (also called a seal) that keeps the gas from escaping.

**Natural gas is also found in other areas, including coal beds, ocean sediments and deep zones as much as 30,000 feet below the earth's surface.*



Experiment

Make a reservoir

In this investigation, you'll learn about some important properties of both reservoir rock and the substances it contains.

Materials:

- 1 small clear jar
- 1 large measuring cup
- 1 tablespoon cooking oil
- Tap water
- Enough playground or beach sand to fill your jar

Set Up: Fill your small jar to the top with sand. Put the cooking oil in your measuring cup and fill the cup with water.

Predict: How much liquid do you think you will be able to add to the jar without it overflowing? _____

Investigate: Slowly pour as much of the water and oil mixture as you can into the jar of sand until it nearly overflows.

Observe: How much liquid did the jar of sand hold?

Reflect:

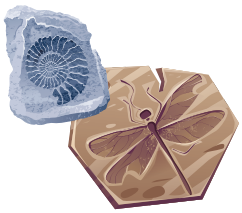
1. Where did the liquid go? _____

2. What substance did the liquid replace? _____

3. Where did that substance go? _____

4. How do the substances in your jar behave like the reservoir rock, water, oil and gas shown in the illustration? How are they different? _____

_____



How did natural gas get here?

Natural gas deposits were formed millions of years ago, long before dinosaurs roamed the earth, when dead plants and tiny sea animals were buried in sand and rock. Their remains decomposed and as a result of the earth's heat and pressure over time, turned into gases trapped deep beneath the surface of the earth.

Make your own fossil

(Materials for 32 fossils)

- 4 cups of used coffee grounds and 2 cups of cold coffee (be sure to ask a teacher or adult to prepare beforehand)
- Measuring cup
- 4 cups plain flour
- 2 cups table salt
- Wax or parchment paper
- Large mixing bowl
- 4 baking trays
- Cookie cutters or empty can
- Small objects to create fossil impressions: dinosaur, fish or insect toys; shells; sturdy leaves; pinecones
- Toothpicks (optional)
- Rolling pin (optional)

Directions:

1. Combine the coffee grounds, cold coffee, flour and salt; mix well.
2. Knead the dough and then flatten it on the wax or parchment paper.
3. Cut out circles with the cookie cutters or can.
4. Press the small objects firmly into the dough, leaving an imprint.
5. Poke a hole near the top edge of your fossil for hanging it later.
6. Let the fossils dry and harden on wax paper on the baking trays for a night or two.

Fossil fun fact

Fossils from sea creatures have been found on Mount Everest, the highest mountain in the world!

Natural gas is known as a **fossil fuel** because it was formed from prehistoric fossilized creatures. A fossil is the remains of life from at least 10,000 years ago. Some fossils are 225 million years old!

The energy we use comes from natural resources

Natural gas can be burned to create heat. It is one of many **natural resources** that people use for their energy needs. Other energy sources that come from nature include:

COAL 

WIND 

 SUNLIGHT

 OIL

WOOD 

GEOTHERMAL 

 MOVING WATER

 BIOMASS

Some energy sources are *renewable*. This means they can be replenished in a short period of time, so they can be used over and over again and will never be all used up. Some are *nonrenewable*, which means they will someday be used up.

Guess and confirm

Read the section above. Circle the energy sources that you think are renewable and put a box around those that you think are nonrenewable. Confirm your answers through research, either online or in your school library.

How natural gas gets to us

Natural gas remained underground for hundreds of millions of years before humans began using it. Today, geologists can locate natural gas very far underground and drill deep holes called **wells** to pump it up to the earth's surface. Utilities use large, buried **pipelines** to carry gas from wells to cities and towns. Smaller pipes bring gas to buildings and into appliances and equipment.

4 steps for an indoor gas leak

In its original state, natural gas is invisible and odorless. Utilities add an odorant called **mercaptan** to natural gas that smells like **sulfur** or rotten eggs. This makes it easier to detect gas leaks, especially indoors.

Gas leaks inside homes are rare but can be dangerous, so it's important to know how to recognize and respond to them.

1. If you smell sulfur or rotten eggs, tell an adult. If no adult is present, get everyone outside quickly.
2. Do not use a light switch, match, candle, flashlight, TV or monitor, remote controller, radio, garage door opener or a phone.
3. Go to a safe outdoor location and ask a trusted adult to report the leak to 911 and your local natural gas utility.
4. Stay away from your home and do NOT go back inside until safety officials tell you it is safe.

Gas leak response

Read the four steps above for what you should do if you smell gas at home. Write on a sheet of paper why you think the items listed in step 2 should never be used near a gas leak. Then complete the puzzle below.

Fill in the missing vowels: A, E, I, O, U, Y

__ t __ n __ sp __ rk fr __ m __ n __ __ f
th __ s __ th __ ngs c __ __ ld __ gn __ t __
l __ __ k __ ng g __ s.

Outdoor gas safety tips

Know the signs of a gas leak!

A leak from an outdoor natural gas pipeline, while rare, can also be a hazard. Learn the warning signs and what to do.

A smell of sulfur or rotten eggs

Continuous bubbling in water

A hissing, whistling or roaring sound

Dirt spraying or blowing, grass or plants dead or dying for no reason

What to do

- Do not use a flame or anything electrical such as a phone, flashlight, electrical device or match. Even the tiniest spark from one of these items could ignite leaking gas.
- **Go far away from the area immediately and do NOT go back until safety officials say it is safe.**
- Ask a trusted adult to report the leak to 911 and National Grid.

Word game: Unscramble these words and use them to complete the paragraph.

TLISHWING	LSAKE	TRICALCELE
_____	_____	_____
ARZHDA	PRTORE	IRDT
_____	_____	_____

Gas pipeline _ _ _ _ _ _ can pose a _ _ _ _ _ _ _ .

Signs of a leak include a _ _ _ _ _ _ _ _ _ _ sound, or _ _ _ _ blowing into the air.
If you suspect a gas leak, do not use anything _ _ _ _ _ _ _ _ _ _ _ _ .

Leave the area and ask an adult to _ _ _ _ _ _ _ the leak.

Help prevent gas pipeline leaks

If people damage underground pipelines while digging, the gas inside them can leak out. So, if you or someone you know is planning a digging project, be sure to notify the 811 service several days before it begins. This service makes sure underground gas pipelines and other utilities, such as sewer and water lines, are clearly marked so that people can dig a safe distance away from them. Dial 811 or use your state's 811 website.

Take the 811 commitment

811 Know what's below. 811 before you dig.

1. Ask each person in your family or household to list any upcoming digging projects they expect to do around their home or at their workplace.
2. If no one has an upcoming project in mind, list some possible reasons for digging, such as planting a tree or building a fence.
3. Get everyone's signature to show their commitment to always notify the 811 service before digging.

I PROMISE TO NOTIFY THE 811 SERVICE BEFORE DOING ANY OF THESE DIGGING ACTIVITIES:

_____

_____

_____

_____ _____

Signatures Date

Spread the word

Create a poster, video or cartoon to teach others what to do if they suspect an indoor or outdoor natural gas leak.

Pipeline markers

Pipeline markers show you the general location of underground gas pipelines and related facilities. These markers include a 24-hour emergency number. If you see any suspicious activity near a pipeline marker, tell an adult to call the emergency number to report it.

Natural gas safety tips

Appliances and equipment

- Always keep papers, dishcloths and paper towels away from your gas rangetop, and secure loose and dangling sleeves while cooking.
- All natural gas appliances use a flame, so keep anything that can burn far away from them. This includes papers, toys, curtains, cleaning products and flammable liquids (like paint thinner).
- No matter what type of fuel you cook with, it is important to disperse food odors, steam and indoor air pollutants by **ventilating** while cooking. Use a built-in range fan, an open window or door, or a portable fan.
- Don't play with oven knobs; you could accidentally turn on the gas.
- Don't play with or hang things from gas pipes.

Keep your eye on the flame

A natural gas flame should be blue. If you see a large, yellow or flickering flame on your gas range, ask an adult to have it checked by a qualified repair person. (Decorative gas appliances such as gas logs may have a yellow flame to make them look like a wood fire or campfire. This is okay and does not indicate a problem.)

Stand up for safety

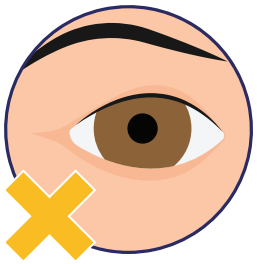
Act! With a partner, act out a scene in which a younger person has just seen an older person do something unsafe around natural gas. Include these roles:

- Younger person: You are afraid to speak up, but you take a risk and do it anyway.
- Older person: At first you criticize the younger person, but they persist. Eventually, you thank them for preventing a hazard.

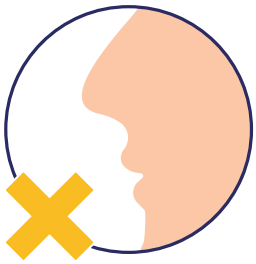
Swap roles and act out the scene again. Then talk with your partner about how you felt in each role.

Carbon monoxide safety tips

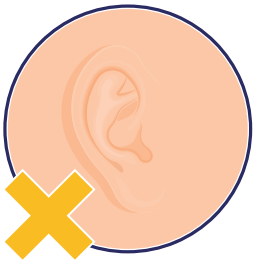
Carbon monoxide (CO) is a colorless, odorless and poisonous gas produced when fuel-burning appliances or equipment malfunction or do not vent properly. Breathing CO can make people feel headachy, tired, nauseous and weak. **Anyone who suspects CO poisoning should leave the building, get fresh air and call 911.**



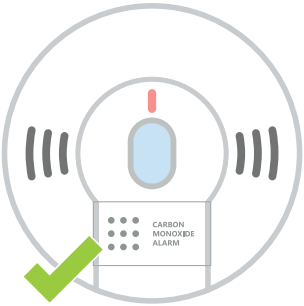
CAN'T BE SEEN



CAN'T BE SMELLED



CAN'T BE HEARD



CAN BE DETECTED

Share these CO safety tips with the adults in your family:

- Never run a vehicle in an enclosed garage – even with the door open!
- Use generators outdoors only, and far from windows, doors and vents.
- Do not use barbecue grills indoors.
- Do not heat a room with a gas range or oven.
- Have your fuel-burning heating equipment and water heater inspected once a year.
- Keep the chimney damper or flue open when the fireplace is used.
- Make sure you have a CO alarm in the hallway near every sleeping area, test it regularly and keep the batteries fresh.

CO math

Find the answer to each problem in the chart, then write the letter from the number it matches in the word puzzle at right.

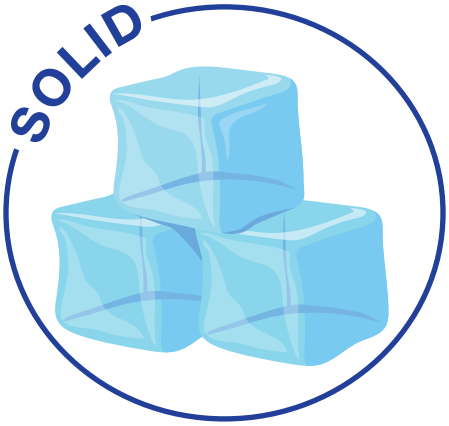
PROBLEM	ANSWER	LETTER
724 + 179		r
17 x 23		a
How many states are in the US?		l
78 ÷ 6		m
352 ÷ 8		a
34 x 13		s

We can't detect CO with our senses, so we rely on CO

$\frac{}{44}$ $\frac{}{50}$ $\frac{}{391}$ $\frac{}{903}$ $\frac{}{13}$ $\frac{}{442}$ to alert us to a problem before the gas reaches dangerous levels.

The 3 states of matter

Everything in the world exists in one of **three different states: solid, liquid or gas.** These are the three states of matter. All three are made up of tiny particles called atoms and molecules, which are far too small to see with the naked eye.



In a **SOLID**, the particles are packed very tightly together. They do not move much, but they can vibrate in their positions. Solids have a fixed volume and shape.

In a **LIQUID**, the particles stay in contact with each other, but they can move more freely than in a solid. Liquids have a fixed volume but take on the shape of their container.

In a **GAS**, the particles are spread out from each other and can move freely and quickly in any direction. Gases can expand to fill the volume of their container (whether a jar or a room) and take on its shape.

Activity center

1. Get physical! With a partner, stand up in an area with plenty of space around you and act out each of the three states of matter for a third person. Imagine what it would feel like to be in each different state. How would you move? What sounds would you make? Have the third person guess which of the three states you are in.

2. Simulate how a gas spreads in air. Fill a glass with cold water and add a drop of food coloring. Observe how the color disperses through the water. This is similar to how natural gas moves in air, with one key difference: Natural gas is lighter than air and will rise as it spreads.

Critical thinking

Thinking about how natural gas behaves, why is it important to protect natural gas pipelines from damage?

Experiment

Balloon blow-up magic

In this experiment, you will see how the states of matter can change by mixing a solid with a liquid to create a gas. The gas produced from the two ingredients is carbon dioxide or CO_2.

Materials:

- 1 empty glass or plastic bottle with small neck
- 1 balloon
- 1 box of baking soda
- 2 small funnels
- 1 bottle white vinegar (12 oz. or larger)

Directions:

1. Have a teacher or other adult supervise this activity. Use one funnel to pour vinegar into the empty bottle so it is ⅓ full.
2. Use the other funnel to pour baking soda into the balloon, about ½ full.
3. Attach the balloon to the top of the empty bottle, pinching off the body of the balloon and letting it hang to the side so that the baking soda does not fall into the bottle.
4. **Predict** what you think will happen.

_____

_____

5. Lift up the balloon so that baking soda falls into the vinegar.
6. **Observe** what happens and record what you see.

_____

_____

7. **Reflect** on what you observed. Why do you think it happened?

_____

_____

Is your family prepared?

GET PREPARED

Prepare for power outages

When the power goes out, your water heater, furnace and cooking appliances may not work. Be prepared with these items, which will help you stay warm and safe during electrical outages.

- A solar or fuel-powered generator
- Solar or battery-powered lanterns, lights, radios and phone chargers
- Carbon monoxide detectors on every floor – these will alert you if harmful CO gas accumulates when using alternative forms of power for lights, heating and cooking
- Propane camp stove with extra fuel for cooking outdoors only (not to be used as a heat source)

Protect your gas equipment

- Gas dryer **vents** keep heat and lint from building up in your dryer and causing a fire hazard. Remind adults to check these and other gas appliance and equipment vents to be sure they are not clogged with snow, ice, grass or debris.
- **Gas meters** can be damaged by heavy snow and ice. Remind adults to gently clear snow, ice or other debris away from this equipment and to remove snow or ice that could fall onto it from above. Never use sharp objects, a shovel or a blower on a gas meter.
- Always keep the path to your gas meter clear so that firefighters can shut off the gas in an emergency and utility workers can have meter access.

BE PROTECTED

BUILD A KIT

Make an emergency kit

Work with your family to make an emergency evacuation kit in case a flood, severe weather, fire, earthquake or other disaster forces you to leave home. Make sure everyone knows where the kit is stored and who will be responsible for taking it along. Collect:

- ❑ Blankets
- ❑ Flashlights
- ❑ Radio
- ❑ Extra batteries
- ❑ First aid supplies
- ❑ Enough food, water and supplies for three days in easy-to-grab backpacks or a large plastic box
- ❑ Cash
- ❑ Medicines
- ❑ Toilet paper
- ❑ Pet food
- ❑ Cell phone car charger
- ❑ One complete change of clothing and shoes per person, including wet-weather gear

Putting it all together

In small groups, create a presentation for the class using at least five of the natural gas safety tips from the list you created or those on pages 7–11 and 14–15 of this booklet. Use Google slides or a poster to present your information.

Home safety inspection

Take this booklet home and work with your family to do this natural gas safety inspection. If you find any hazards, check “Needs fixing” and ask an adult to have them fixed.

Look for:

1. **Small children playing near the gas range or other gas appliances.**
   ◯ None ◯ Needs fixing ◯ Fixed
2. **People digging without having first called 811 to get buried utility lines marked.**
   ◯ None ◯ Needs fixing ◯ Fixed
3. **A natural gas oven being used to heat the kitchen or to dry clothes.**
   ◯ None ◯ Needs fixing ◯ Fixed
4. **A yellow flame on your gas range.**
   ◯ None ◯ Needs fixing ◯ Fixed
5. **Papers, clothing, curtains and flammable liquids near open flames or heaters.**
   ◯ None ◯ Needs fixing ◯ Fixed
6. **The chimney flue and appliance vents clogged or in disrepair.**
   ◯ None ◯ Needs fixing ◯ Fixed
7. **Laundry hung on gas or water pipes to dry.**
   ◯ None ◯ Needs fixing ◯ Fixed

If you suspect a natural gas leak, leave the area immediately. From a safe location, ask an adult to call **911** and **National Grid**.

Produced by Culver Media for National Grid

nationalgrid